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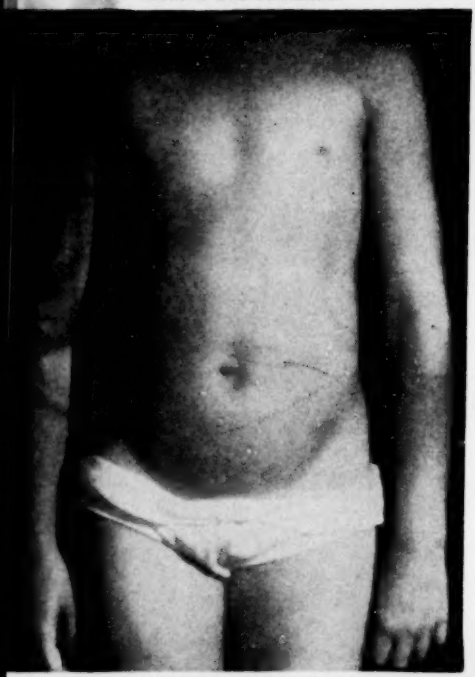

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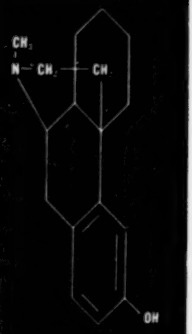

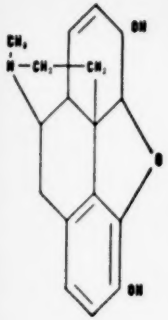

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constipation	rare	frequent
disorientation	rare	frequent
depressed appetite	rare	frequent
nausea	less	occasional
vomiting	less	occasional

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for

September 1

1952

Modern Medicine

Vol. 20, No. 17

●

THE MAN ON THE COVER is Dr. Robert H. Kennedy of New York City, Professor of Clinical Surgery at the New York University Post-Graduate Medical School and guest editor of the Symposium on Trauma beginning on page 65. Dr. Kennedy is surgical director of Beekman-Downtown Hospital and attending surgeon at University and Bellevue hospitals. First vice-president elect of the American College of Surgeons, he has served as chairman of its Committee on Trauma since 1939. He is also a member of the American Surgical Association, American Association for the Surgery of Trauma, New York Academy of Medicine, International Society of Surgery, and the Society of Medical Consultants to the Armed Forces.

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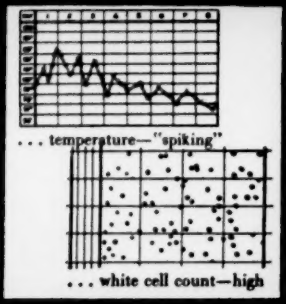
URINARY TRACT

Pyelonephritis

Pyelonephritis occurs most often in the young child . . .

commonest in the "diaper-age" female

The onset is sudden, usually with a chill . . .



. . . temperature—"spiking"

. . . white cell count—high

Always pus cells and bacteria appear in the urine

look for *clumps* of white cells in *catheterized* specimens

Culture determines pathogen . . . Mixed infection not uncommon

in 8 out of 10 children, colon bacillus invades

Sometimes there is tenderness over the kidney region . . .

try the McKnight punch, or

palpation in C-V angle

. . . abdominal pain and rigidity . . .

suggestive of an acute abdomen

Look for a cause of urinary stasis . . .

in children, 75% have congenital malformation . . . others may have calculus, foreign body, neoplasm, ureteral spasm.

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LETTER FROM THE EDITOR

Dear Reader:

One of my friends who practices urology came into my office the other day holding a copy of *Modern Medicine* open at the page listing the National Editorial Board.

"I see you have Dr. So-and-so writing for your journal," he said. "He's a fine urologist and a friend of mine, and busy as blazes. How can he find the time to write for you?"

I explained that the members of the editorial board do not write the reports in *Modern Medicine*. They do perform a job that is even more important to the reader. They select the material that is to be reported. Each member of the board reads all the current literature in his own field. Significant articles of interest to a wider circle of readers than the specialty journal reaches are earmarked for *Modern Medicine*.

These articles are then assigned to carefully trained and experienced science writers, who write the concise, fact-packed reports that *Modern Medicine* readers demand. Our staff artist prepares illustrations to aid comprehension of difficult points. Our editors revise and polish each report until the meaning stands out unmistakably clear and with the proper emphasis. The finished report is readable, reliable, and quickly grasped.

This is the selective reporting that makes *Modern Medicine* of unique value to the reader. It is not the product of one man, but of many, each an expert in his particular field and each working toward a common goal: the accurate presentation of significant medical developments to the doctors of America in the shortest possible time.

Walter C. Alvarez

EDITOR-IN-CHIEF

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(Am. J. Obst. & Gynec. *61*:1366, 1951)

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Correspondence

Communications from the readers of MODERN MEDICINE *are always welcome. Address communications to The Editors of* MODERN MEDICINE, *84 South 10th St., Minneapolis 3, Minn.*

Figures Transposed

TO THE EDITORS: I have just noticed that on page 80 of your June 15, 1952 issue a very grievous error was committed in reporting an article by Dr. Charles L. Fox and associates on a balanced electrolyte solution.

For those familiar with the subject the error is very obvious, but I wonder if the medical practitioner would detect this so easily. Should he follow your excerpt, instead of checking with the original article in preparing such a solution for clinical use, the results might be unpleasant if not actually deplorable.

In quoting the authors' table giving the composition of plasma and of the electrolyte solution the values for Cl− and HCO_3− have unfortunately been transposed.

I think that a correction should be published promptly in a conspicuous place.

S. MORGULIS, M.D.

Omaha

The correct table of composition is

	Plasma	*Electrolyte Solution*
Na +	140	140
Cl −	103	103
HCO_3 −	27	55
K +	5	10
Ca ++	5	5
Mg ++	3	3

Cracks on Fingers

TO THE EDITORS: *Modern Medicine* contains so many valuable items that I have formed the habit of saving it. In looking over the July 1, 1951 issue (p. 44), I observe a question concerning a woman who suffers from cracks in her fingers. I should like to describe 2 cases in my experience.

Both women were past middle age and had been tortured for some years with this most annoying affliction. Especially in cold weather, the skin on the fingers would suddenly burst open and often bleed a little, leaving a painful area for one or two days.

One patient used Priscoline for about a week and felt benefited; some months later she obtained much relief from a recurrence by the use of Calthenamine ointment. The second patient was also gratified with the results of Calthenamine.

Moderate low-salt diets were without apparent benefit.

CLARA S. WEBSTER, M.D.

Tucson

Misplaced Emphasis

TO THE EDITORS: As a regular and interested reader of your journal, I was disturbed by the poten-

at that age
when the taste
of things can be
so important...

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tially misleading emphasis placed upon boric acid poisoning in Diagnostix *(Modern Medicine,* Mar. 1, 1952, p. 166) together with the associated cartoon. Perhaps the text itself would not be misleading since it is clearly stated that the mother involved in this particular case applied pure boric acid powder to the diaper area, yet it appears worthwhile to call this to your attention.

While it is recognized that boric acid is a potentially toxic agent when misused and has been the cause of death in certain instances when either accidentally ingested in fairly sizable quantities or applied to extensive lesions of the integument resulting from burns or other causes, under conditions resulting in prolonged contact, there is no instance of local or systemic toxicity known to have resulted from the use of baby powders containing concentrations of boric acid in the neighborhood of 5%.

The cartoon associated with the case description leaves the impression that the mother is applying ordinary baby powder, since the outline of the container she is holding, while very crude, is strongly reminiscent of the type of baby powder cans widely sold in drugstores throughout the nation.

JOHN HENDERSON, M.D.
New Brunswick, N. J.

► TO THE EDITORS: During the past several years there has appeared an increasing number of papers, by Abramson, Brooke, Watson, and others, reporting deleterious effects and even death from the use of boric acid as a therapeutic agent.

Our interest in boric acid dates back to 1923 and 1926 when Kahlenberg and Barwasser, by numerous experiments, clearly demonstrated that boric acid in solution is readily absorbed through the intact skin and appears in the urine in a short time. In a more recent paper we commented on the efficacy of boric acid as an auxiliary agent in therapy because of this property. However, at that time, we were unaware of the above reports of percutaneous boric acid deaths, some of which were as yet unpublished.

Also as a dermatologist I am now particularly interested in the problem which these reports present and I feel that it is of vital importance that the following question be definitely settled: Is boric acid per se a toxic substance in all concentrations and in all persons when used therapeutically or only in those who have an individual idiosyncrasy to the drug?

NORBERT C. BARWASSER, M.D.
Moline, Ill.

Plea for Practical Education

TO THE EDITORS: It is my belief that the following plan will go far to combat socialized medicine, will result in a more equal distribution of doctors, will prevent the staggering debt now incurred by the medical student or his parent, and will prevent the long, useless grind incurred by the student. Surely our present plan has reached the extreme of extremes. I dread to see us swing to the other extreme, and the old adage that "men go from one extreme to another" may some day apply to medical education.

So the following is a middle-ground plan, as I see it. Divide our medical curriculum into about 10 or 12 special courses. The student would get his M.D. degree, but he would major in, for instance, general practice, internal medicine, general surgery, neurosurgery, orthopedics, pediatrics, ophthalmology, obstetrics and gynecology, otorhinolaryngology, psychiatry, dermatology, or urology. The student's diploma, of course, would designate his specialty. The location where he must practice for three years would be selected for him by a special board. After that time he would be free to move at will.

With this plan, we would expect to place the general practitioner in a good village or rural community for the three-year period. The general surgeon and the pediatrician might be placed in the average county seat town of a few thousand. The rarer specialists, such as the neurosurgeon, might be placed in a larger center of some 40,000 or more. The odds are that the vast majority, after an "initiation period" of three years, would remain where originally placed. The graduate now has but the faintest idea where to get the best location. Surely a special board, trained in obtaining locations, would be a real service to the graduate and to the various communities.

It is to be presumed that the

(Continued on page 26)

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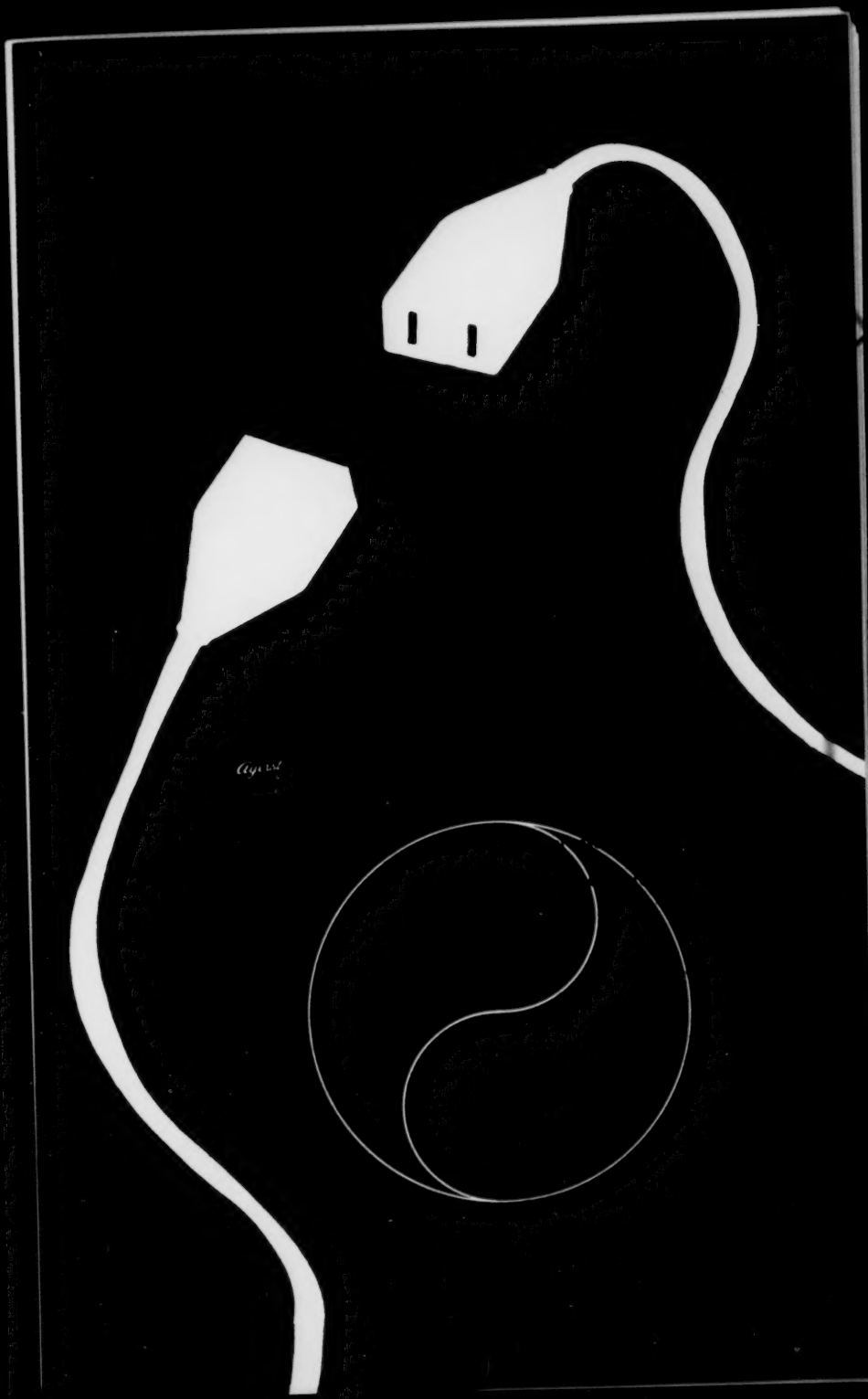

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course would be four years in majoring for the special degrees, but by the third and fourth years the student could be performing the functions of an intern in his selected field and, on graduation, would not require such a long internship.

Colleges should admit only English-speaking students, but there probably should be one school in the whole United States with Spanish-speaking teachers for Spanish-speaking students. Nothing is more difficult than teaching medicine to one who has only a limited knowledge of English.

I believe the reader will agree that part of our pre-med course could be omitted without detriment. One year should be sufficient for high school graduates. In my own class of 1909, some splendid students had only academy training, which was only a few steps ahead of the three R's.

Let us imagine a class of 100. The course would not be as difficult, unless it be that of the general practitioner, as at present. Say for instance:

50 will be in general practice
7 in general surgery
2 in neurosurgery
7 in internal medicine
4 in orthopedics
5 in ophthalmology
5 in gynecology
4 in pediatrics
4 in otorhinolaryngology
4 in psychiatry
4 in dermatology
4 in urology

While any educator could greatly improve on these figures, to my mind it would represent an ideal situation, probably utopian. Surely it would be comforting to the student to feel that he was not grinding in nonessentials at the expense

corrects chronic constipation with no side effects

case of R. I. Sex F Age 54

Marked, prolonged constipation and obesity of life-long duration. (History of domestic problems and cathartic-addiction.)

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of his own special work, that some "board of location" was set up to find a good place for him, that he would study in his own language, and that he wouldn't be too old and too deeply in debt when he did make his start.

A. B. GRUBB, M.D.
Cripple Creek, Va.

Job Well Done

TO THE EDITORS: Thank you for the excellent editorial work on my article "The Adenoid Problem" (*Modern Medicine*, June 15, 1952, p. 101). Your editor did a better job than I could have done. Also, the illustrations in color were a vast improvement over my pencil drawings. I wish I could have had your artist to illustrate the original article.

PAUL GUGGENHEIM, M.D.
Council Bluffs, Iowa

Separates Wheat from Chaff

TO THE EDITORS: The special exhibit on diskography (*Modern Medicine*, June 1, 1952, p. 104) was excellent. I find your journal almost indispensable. It separates the wheat from the chaff. Best wishes and more power to you.

MORRIS KAPLAN, M.D.
New York City

If Anemia Therapy Is to Be More Effective It...

"...should provide an abundance of those articles which, according to clinical experience and animal experiment, have been shown best to promote regeneration of blood..."

"...should include in adequate amounts all essential nutritive elements..."[2]

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HEPTUNA PLUS supplies balanced amounts of Vitamins, Minerals, and Trace Elements to assure adequate intake of essential nutrients.

1. McLester, J. S.: Nutrition and Diet in Health and Disease. Ed. 5. (Philadelphia: W. B. Saunders and Co.) 1949, p. 636. 2. *Ibid.*

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COPPER	1 mg.
MOLYBDENUM	0.2 mg.
CALCIUM	37.4 mg.
IODINE	0.05 mg.
MANGANESE	0.033 mg.
MAGNESIUM	2 mg.
PHOSPHORUS	29.0 mg.
POTASSIUM	1.7 mg.
ZINC	0.4 mg.
VITAMIN A	5,000 U. S. P. UNITS
VITAMIN D	500 U. S. P. UNITS
THIAMINE HYDROCHLORIDE	2 mg.
RIBOFLAVIN	2 mg.
PYRIDOXINE HYDROCHLORIDE	0.1 mg.
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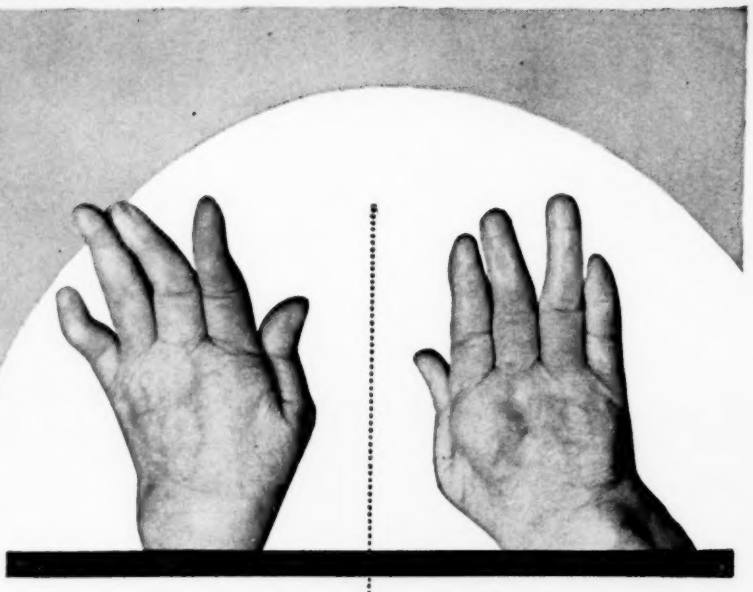
1. Cronk, G. A.: Arch. Dermat. & Syph. (In press.)
2. Cronk, G. A., and Naumann, D. E.: J. Lab. & Clin. Med. 37:909, 1951. 3. Carrier, R. E., Krug, E. S., and Glenn, H. R.: Journal-Lancet 68:240, 1948.

CIBA Pharmaceutical Products, Inc., Summit, New Jersey

2/1819M



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Vitamin D	400 U.S.P. Units	100%
Vitamin B_1	1.5 mg.	100%
Vitamin B_2	3 mg.	100%
Nicotinamide	15 mg.	100%
Vitamin C	150 mg.	100%
Iron	15 mg.	100%
Calcium	1500 mg.	100%
Phosphorus	1500 mg.	100%
Pyridoxine	1.5 mg.	**
Vitamin B_{12}	3 mcg.	**
Folic Acid	1.2 mg.	**
Cobalt	0.3 mg.	.....
Copper	3 mg.	.....
Iodine	0.45 mg.	.....
Magnesium	18 mg.	.....
Manganese	3 mg.	.....
Potassium	15 mg.	.....
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#RDA in pregnancy 1500 mg., in lactation 2000 mg.
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Questions & Answers

All questions received will be answered by letter directed to the petitioner; questions chosen for publication will appear with the physician's name deleted. Address all inquiries to the Editorial Department, MODERN MEDICINE, *84 South Tenth Street, Minneapolis 3, Minnesota.*

QUESTION: Routine examination of a 19-year-old primipara, six weeks' gravid, reveals a moderately heavy trace of albumin; a catheterized specimen shows the same. Blood pressure is 125/75. She has had measles, mumps, whooping cough, scarlet fever, and flu. Recovery in each was uneventful. What procedure do you suggest? Have statisticians ever analyzed a good series in this category?

M.D., New York

ANSWER: *By Consultant in Obstetrics.* Albuminuria during early pregnancy may be benign but suggests vascular renal disease. Kidney function tests including the phenolsulfonphthalein, urea clearance, concentration tests, and the Addis count of the urinary sediment should be performed. If no evidence of renal involvement is found, specimens of urine obtained after rest should be examined to determine orthostatic albuminuria. Normal blood pressure and ocular fundoscopic study will determine the vascular status.

If renal function is disturbed, the cause should be sought. Chronic nephritis or chronic pyelonephritis may be seriously aggravated during pregnancy and thus endanger both mother and baby. Pyelograms may be indicated to discover mechanical disturbances of the ureter or congenital disturbances such as polycystic kidneys. Careful study will determine the degree of kidney insufficiency, if present, and point out the danger of continuing the pregnancy. I know of no statistics expressing end results in tracing albuminuria during early pregnancy.

QUESTION: I have a patient with a large port-wine type of angioma on her face. Is tattooing of these disfiguring skin areas considered an acceptable procedure, and are the cosmetic results satisfactory? Have any recent advances been made in the treatment of these angiomas?

M.D., Montana

ANSWER: *By Consultant in Dermatology.* Not enough work has yet been done with tattooing to be able to judge the results. Some favorable effects have been reported from the use of sandpaper to abrade the surface. The resultant superficial scarring is said to be much more satisfactory than the original condition. Several plastic surgeons have been working with this technic, but the treatment probably should not be generally recommended as yet. Claims have been made, too, for the efficacy of grenz-ray therapy, but I am not sure how much is really gained for the patient.

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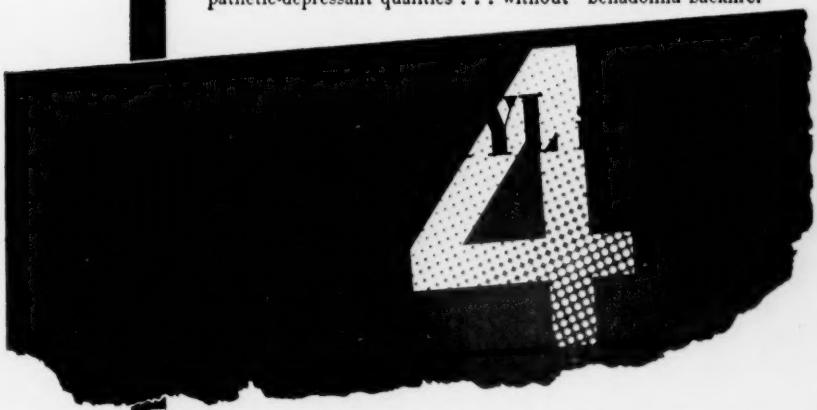
2. ***Protecting the crater.*** KOLANTYL includes a superior demulcent (methylcellulose, a synthetic mucin) which forms a protective coating over the ulcerated mucosa.

3. ***Blocking spasm.*** KOLANTYL includes a superior antispasmodic (Bentyl) which provides direct smooth-muscle and parasympathetic-depressant qualities . . . without "belladonna backfire."



4. ***Inactivation of lysozyme . . .*** with a proven antilysozyme, *sodium lauryl sulfate.* Laboratory research[1,2,3] and clinical results[4] indicate that the enzyme lysozyme is one of the etiologic agents of peptic ulcer. By inhibiting or inactivating lysozyme, KOLANTYL—and *only* KOLANTYL—provides the important 4th factor toward more complete control of peptic ulcer.

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DOSAGE: Two tablets every three hours as needed for relief. Mildly minted. Kolantyl tablets may be chewed or swallowed with ease.

1. Meyer, K. et al. Am. J. Med. 5:482,1948. 2. Wang, K. J. and Grossman, M. I. Am. J. Phys. 155:476,1948. 3. Grace, W. J. Am. J. Med. Sc. 217:241,1949.
4. Hufford, A. R. Rev. of Gastroenterology. 18:588, 1951.

Trademarks "Kolantyl," "Bentyl"

Forensic Medicine

ARTHUR L. H. STREET, LL.B.

Prepared especially for Modern Medicine

PROBLEM: A physician tried an abortion upon a pregnant woman. Two days later, believing that a second operation was necessary, he operated again. Was he guilty of two distinct offenses?

COURT'S ANSWER: Yes.

The California District Court of Appeal, Second District, noted that consummation of an abortion is not essential to a violation of the California statutes, which make criminal an illegal act intended to produce miscarriage. So distinct acts committed at different times are distinct offenses (242 Pac. 2d 403).

PROBLEM: A doctor was dismissed from the medical staff of a hospital operated by a Roman Catholic sisterhood because of nonmembership in the county medical society and of unfavorable publicity reflecting upon his moral character. Was he entitled to a court order requiring his reinstatement?

COURT'S ANSWER: No.

The Iowa Supreme Court decided that the hospital was a private one operated as a private business, although it was open to the public for paying or charity patients and received governmental aid. As such it could grant to doctors and withdraw privilege to use its facilities. It was the exclusive power of the governing board to determine whether the physician should be dropped from the medical staff under the circumstances, without affording him the opportunity of a hearing (52 N. W. 2d 701).

PROBLEM: A doctor owned a house in a New Jersey district covered by a zoning ordinance which authorized use of the residence for consulting patients. The title to the property limited use to dwelling purposes and forbade use for "trade or business." Was an adjacent property owner entitled to an injunction against construction of an addition to the doctor's house for office use, the plans conforming to the zoning ordinance?

COURT'S ANSWER: No.

The New Jersey Superior Court, Chancery Division, recognized that a zoning ordinance cannot override a restriction embodied in the title to real estate, but decided that medical practice was not a "trade or business" within the meaning of the title restriction (88 Atl. 2d 262).

The court approved a distinction made by the Florida Supreme Court, between a "trade" or "industry" and a "profession" such as medical practice. A Florida doctor was acquitted of a charge of pursuing his profession in a district

(Continued on page 41)

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1. Reported at the 41st Annual Meeting of the American Society for Pharmacology and Experimental Therapeutics in Cleveland, Ohio; Federation Proceedings, Vol. 10, March 1951, p. 490.
2. Weiss, A. and Feldman, D.: A Heart Muscle Extract in the Treatment of Cardiovascular Disease, J. Lancet (August) 1951, pp. 320-322.
3. The subject of more than 50 clinical trials for many years by physicians in private practice.

- MYOCARDONE advantageously replaces or augments digitalis therapy in decompensated patients.
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- MYOCARDONE administration caused . . . "increased capacity for exertion, decrease or disappearance of symptoms requiring nitroglycerin in the anginal cases, and in disappearance of orthopnea, pulmonary congestion and edema in the decompensated cases."[1]
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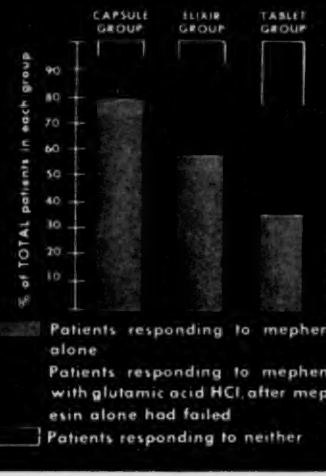

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Hydrochloride . . . . . 0.25 Gm.

"Until this combination therapy has failed, mephenesin should not be discarded as ineffectual"[1]

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where trade and business were banned by a zoning ordinance. The Florida court noted that, applied to doctors, the ordinance would unreasonably make it illegal for a physician to visit his patients in a residential district (176 So. 753).

PROBLEM: Was a judge's finding of a wife's mental incapacity to form an intent to desert her husband sufficiently supported by testimony of laymen and a physician who had attended her for many years, although he was not a psychiatrist?

COURT'S ANSWER: Yes.

The U. S. Court of Appeals, District of Columbia, said that, in civil cases involving a person's mental capacity in such matters as making wills and so forth, a physician, though not a psychiatrist, may, like a layman and with the same effect, express opinions, for the guidance of the court or jury, as to a person's mental condition. This assumes, of course, that the opinion is based upon reasonable opportunity to form it from acquaintanceship with the person (195 Fed. 2d 763).

The court quoted the U. S. Supreme Court, "The mental condition of an individual, as sane or insane, is a fact, and the expressed opinion of one who has had adequate opportunities to observe his conduct and appearance is but the statement of a fact."

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Basic Science Briefs

Obstetrics

Water Balance in Pregnancy

The antidiuretic effect of Pitressin is inhibited by incubation with the blood of pregnant women. The altered water and electrolyte metabolism in pregnancy, particularly in toxemic patients, may be due to a decrease in this inactivating ability. Dr. Charles P. McCartney and associates of the University of Chicago and Chicago Lying-in Hospital find that plasma from women past the eighteenth week of pregnancy inactivates Pitressin. Little or no inactivator is demonstrated before the eighteenth week. No qualitative difference is found between the Pitressin-inactivating ability of normal and toxemic pregnant patients. The antidiuretic inhibitor of pregnant patients' blood is located in the plasma and does not cross the placental membrane.

Am. J. Obst. & Gynec. 63:847-853, 1952.

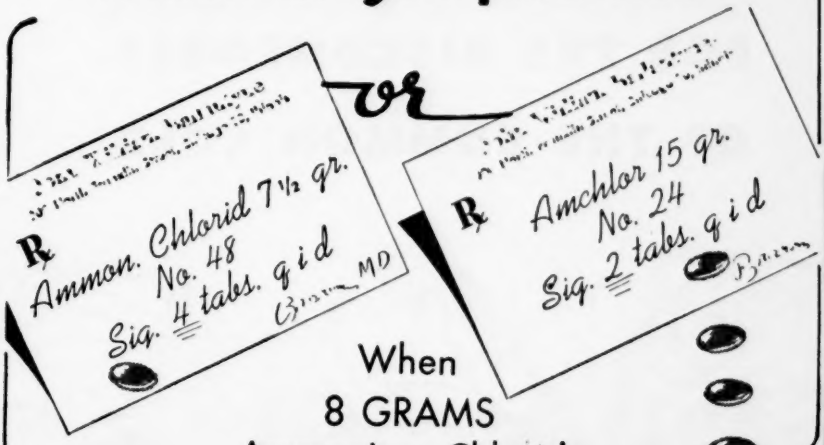
Osteology

Creeping Substitution in Bone Grafts

New bone formation by transplanted tissue may be due to the osteogenetic activity of the transplanted tissue, the ability to induce host tissue to form new bone, or both. The mechanism of new bone formation may be studied by microscopic examination of tissue fragments allowed to grow in the anterior chamber of a rat's eye. Autogenous implants of ear or semilunar cartilage, fracture hematoma, muscle, fascia, tendon, capsular ligament, urinary bladder epithelium, or ureter do not produce bone. Periosteum from immature animals or fracture sites and cortical bone are histotypic, producing only compact bony tissue. Autogenous implants of bone marrow, fibrocartilaginous callus, cancellous bone, and epiphyseal and articular cartilage are organotypic. The osteogenetic activity of these implants gives rise to ossicles complete with cortex and hematopoietic bone marrow. The process of induction may also influence the bone growth produced by cancellous bone and cartilage from epiphyses and articular surfaces. Devitalized fibrocartilaginous callus may also induce new bone formation. Drs. Marshall R. Urist of the Veterans Administration Medical Center, Los Angeles, and Franklin C. McLean of the University of Chicago believe that new bone growth from devitalized tissue, such as boiled or frozen fibrocartilaginous callus, and the creeping substitution seen in bone grafts are essentially processes of induction. Histologic evidence favors the concept of inductor substances remaining in devitalized bone and eliciting osteogenetic activity from ingrowing connective tissue cells of the host.

J. Bone & Joint Surg. 34A:443-476, 1952.

Which do you prescribe?



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Hematology

Humoral Blood Changes with Tuberculosis

Plasma protein changes, serum lability, and sedimentation rate are of diagnostic and prognostic importance in evaluation of patients with tuberculosis. The humoral changes in the blood during tuberculosis affect mostly the protein values, which in turn influence the sedimentation rate. Although an unspecific defense mechanism, these protein changes indirectly allow estimation of specific defense processes, explain Drs. Ph. Klee, H. Hörlein, and K. Jahnke of the City Hospital, Wuppertal-Elberfeld, Germany. As with any infection, the albumin-globulin ratio is shifted toward globulinemia. The electrophoretic globulin fraction analysis reveals two diametrically opposed pictures of the disease: the exudative and the productive. In purely exudative forms, the alpha globulins are increased, especially the alpha-2 fraction. In chronic productive forms, gamma globulins are prevalent. The globulin fraction relation varies and changes according to the form and stage of the evoluting process. Three subgroups are also discernible: [1] toxic-anergic in which the alpha globulins are increased, chiefly the alpha-1 fraction, [2] caseous-cavernous with increase of the gamma globulins after a pronounced clinical change in the process, and [3] amyloid nephrosis, showing considerable increase of alpha and beta fractions. Constant appraisal of the globulin fractions presents as reliable data as do roentgenograms, but before roentgen evidence of the change is noticeable. Of similar value to the globulin formula are the serum lability tests, especially the Weltmann and Takata reactions. The Weltmann heat-coagulation test shows a pronounced shift to the left in active and extensive forms of tuberculosis, whereas a shift to the right usually indicates a tendency to heal. Carcinoma, cerebromalacia, and amyloidosis also give a shift to the left; liver damage produces a shift to the right. Differentiation, however, between these conditions and tuberculosis is relatively easy to make. The Takata reaction appears of more value in estimating the effects of chemotherapy than the course of the disease. The sedimentation rate is important in appraisal, except when thiosemicarbazone is used for therapy. The drug has an inhibitory effect on the sedimentation rate without concomitant favorable change in the albumin or globulin ratio.

Deutsche med. Wchnschr. 77:525-528, 1952.

"Same old occupational disease, eh, Senator?"

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them
down

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Any patient receiving a diuretic should ingest daily a glass of orange juice, a banana, or other supplementary source of potassium.

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In an unusually thorough clinical study recently reported, Lund* was able to diagnose the presence of true iron deficiency anemia of pregnancy and to evaluate *with a high degree of accuracy* its response to therapy.

NEW DETERMINATIONS SHOW TRUE BLOOD PICTURE

Accuracy in diagnosis and evaluation of response to treatment was made possible by combining new biochemical diagnostic determinations—*blood volume, erythrocyte protoporphyrin, total hemoglobin mass*—with hematologic studies routinely used in clinical practice. These newer techniques permit a more accurate appraisal of the anemic state and its response to therapy since they take into account the definite but widely varied increases in plasma volume that occur during pregnancy. Such increases in blood volume, of course, considerably limit the usefulness of routine blood counts during pregnancy.

THERAPEUTIC RESPONSE TO MOL-IRON

". . . the oral administration of a molybdenum ferrous sulfate compound (Mol-Iron) effectively treated 95 per cent of a group of . . . patients with iron deficiency anemia of pregnancy."

Six weeks' treatment with Mol-Iron—providing 240 mg. elemental iron daily—produced *increases in total hemoglobin mass of 80 to 87 per cent.*

"In the severely anemic patient molybdenized ferrous sulfate (Mol-Iron) will assist in the regeneration of 45 Gm. of hemoglobin per week *or the equivalent of a 350 cc. blood transfusion.*"

The author observed an average

*Lund, C. J.: Studies on the Iron Deficiency Anemia of Pregnancy, Am. J. Obstet. & Gynec. 62:947 (Nov.) 1951.
(Reprint available upon request)

Iron-Deficiency Pregnancy Anemia

hemoglobin gain of 2.9 Gm. per cent in 4 weeks of Mol-Iron therapy during late pregnancy; this is almost identical with the frequently reported figure of 2.8 Gm. per cent in 3.7 weeks following *intravenous* iron.

RESPONSE TO MOL-IRON THERAPY

		BEFORE TREATMENT	WEEKS OF TREATMENT					
			2		4		6	
	TIME	MEAN	MEAN	% INCREASE	MEAN	% INCREASE	MEAN	% INCREASE
Hgb. Gm. %	Early*	7.4	8.9	13	9.6	26	9.7	28
	Late†	7.1	9.0	20	10.0	36	10.6	47
Total hgb. Gm.	Early	327	416	27	512	56	612	87
	Late	335	407	20	507	54	595	80

*Treatment initiated during the period of rising plasma volume (before 32 to 34 weeks gestation).
†Treatment initiated thereafter.

WELL TOLERATED

Of a total of 75 patients receiving Mol-Iron therapy, Lund observed only one (1.3 per cent) who was unable to continue the medication because of gastrointestinal disturbances.

SUGGESTED THERAPEUTIC PLANS

"The results of this study suggest the following therapeutic plans. If the anemia is discovered during the first or second trimester, active treatment with iron will not only restore the normal amount of hemoglobin, but will also reproduce the normal increase in total hemoglobin. Treatment may be stopped at delivery. If the anemia is discovered during the last trimester, full normal response is not usually obtained before delivery; in such cases the treatment should continue for 6 or 8 weeks postpartum."

COMMENT

Utilizing newer biochemical determinations, this study* indicates that Mol-Iron is an exceptionally effective iron preparation. Thus it gives strong emphasis to the already extensive evidence that has accumulated demonstrating the definite therapeutic superiority of Mol-Iron.[1-8]

Mol-Iron supplied as: Mol-Iron Tablets, Mol-Iron Liquid, Mol-Iron Drops, Mol-Iron with Calcium and Vitamin D (capsules), Mol-Iron with Liver and Vitamins (capsules). White Laboratories, Inc., Kenilworth, N. J.

1. Dieckmann, W. J., and Priddle, H. D.: Am. J. Obstet. & Gynec. *57*:541, 1949.
2. Dieckmann, W. J., and Associates: Am. J. Obstet. & Gynec. *59*:442, 1950.
3. Forman, J. B.: Conn. State M. J. *14*:930, 1950.
4. Talso, P. J.: J. Insurance Med. *4*:31, 1948-49.
5. Chesley, R. F., and Annitto, J. E.: Bull. Margaret Hague Mat. Hosp. *1*:68, 1948.
6. Healy, J. C.: J. Lancet *66*:218, 1946.
7. Neary, E. R.: Am. J. Med. Sc. *212*:76, 1946.
8. Kelly, H. T.: Pennsylvania M. J. *51*:999, 1948.

Washington LETTER

The Unusual Story of the New Social Security Law

SOME time after the Eighty-third Congress convenes in January it will be expected to reenact a section of the Social Security law that already has run an unusual, if not unprecedented, course through both houses. The section is designed to "freeze" the Social Security status of a person who is disabled, so that his ultimate pension and other rights will not be reduced by averaging into his income the years when his earnings were reduced or nonexistent.

So far so good. Not one member of Congress objects to the general idea nor is it opposed by American Medical Association or other professional groups. The argument comes over how a medical determination of physical disability is to be reached. Is the Federal Security Administrator to supervise examinations by regulations? Are doctors to be allowed to certify disability, with no check on their decisions? Should states have the responsibility of supervising doctors who make the examinations?

Because Congress couldn't solve the problem, it ingeniously wrote into the law a dummy section that sounds good but means almost nothing. It will be up to the next Congress to make another try. Nonsensical as this procedure seems, it did allow for passage of the law with its other provisions, which increase benefits for 8 million Social Security and Old Age Assistance beneficiaries, beginning October 1.

"What d'ya know. The British Medical Association wants to distribute 10,000 barrels of apples."

Passage of this law—H.R.7800—is a classic example of how Congress can operate in the public interest, if it wants to, despite bitter head-on conflicts of politics and personalities.

Originally the bill came up for passage in the House and under a streamlined, debate-limiting procedure, without any public hearings. This first draft put all power over medical ex-

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aminations specifically in the hands of the Federal Security Administrator, who also could deny benefits to a disabled person who refused to take treatments under a state vocational rehabilitation program.

AMA and a few other professional groups hurriedly threw all their weight in opposition to the disability section. The House sent the bill back to committee, and its opponents immediately were accused of "blocking pension increases for the old people." Language was changed slightly and the bill offered for another vote. The opponents were not satisfied, but this time the House, worried about elections, approved the bill anyway, and by an overwhelming vote.

AMA and other critics of the disability section then presented their objections to the Senate Finance Committee, which also held closed meetings. But the Senate committee agreed that more study was needed—at the least, that open hearings should be held before passage of the section. So the Senate passed the bill without the disability section.

By now, time was running short. If the Senate and House conferees couldn't agree, the prospect was that the bill would die with adjournment and that voters in the November election would remind representatives and senators of their failure.

Conferees held three long and bitter sessions, the final one ending just a few hours before the scheduled adjournment of Congress. Rep. Robert Doughton (D., N.C.), chairman of the Ways and Means Committee and "father of Social Security," headed the House conferees. He was retiring, and he demanded that the bill be passed—

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with the section on disability definitely included. Battering Doughton from the Senate side was Sen. Walter F. George (D., Ga.), Chairman of the Finance Committee, who had pledged the Senate that the disability provision would not become law until hearings had been held.

In those three sessions of the conference committee, an agreement was hammered out that came closer to a true compromise than anything worked out in months of sedate discussion.

The following was agreed upon—and now, strange as it seems, is the law of the land:

Supervision of the medical examinations to establish disability will be in the hands of the states; states may delegate the chore to an appropriate state agency.

But, claims under the law may not be received until July 1, 1953, just one day after the date on which the entire section automatically is written off the books. Now, unless Congress reviews the subject and enacts a new section or extends this one, there will be no provision for freezing a disabled person's Social Security rights.

So Mr. Doughton goes into retirement happy, his 40 years of congressional service closing on another achievement in Social Security, a law written just the way he said it would be written and passed.

Sen. George, too, is satisfied. His committee can study the section be-

(Continued on page 58)

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When LIFE HUNG BY A HAIR

IT IS strange that more research has not been done on the causal relationship of asthma and cosmetics. Here is a large and fertile field for investigation. The number of substances used in cosmetics is almost endless, and their use is almost universal. That cosmetics can precipitate near fatal attacks of asthma is well illustrated by the case of the cyanotic infant.

It was late at night, and for the third time, a Brooklyn physician was roused from his sleep by a desperate emergency call. A six months old baby was writhing, gasping and cyanotic from an acute asthmatic seizure.

The baby was rushed to the hospital, placed in an oxygen tent, adrenalin administered, and after a difficult night in which life actually hung in the balance, was finally relieved of its symptoms.

This was the third time that such an emergency had occurred in this infant. In the intervening time, a long series of fruitless tests had been made to isolate the allergen or allergens which precipitated the seizures. Since the infant remained symptom-free while in the hospital, it became quite evident that the causative allergen was something in the child's home environment.

Finally, the mother's dander was tested on the infant with dramatic results. It was found that the substance responsible for the attacks was the Karaya Gum contained in the wave set used by the mother. Shortly after a hair set, this gum flaked off from the hair, and precipitated the severe asthmatic attack in the infant.

Sensitivity to Karaya Gum is by no means rare. It has been described by a number of investigators as precipitating asthmatic attacks, both as an ingestant (ingredient of gum drops, ice creams, salad dressings, laxatives), as well as an inhalant from hair-setting solutions and hand and skin lotions.

Since women with Karaya Gum sensitivity still find it necessary to set their hair for more attractive appearance, your Medical Detective has had frequent occasion to prescribe AR-EX Wave Set for these patients. AR-EX Wave Set is an excellent preparation for this purpose, since quince seed is used as the mucilaginous agent, and quince seed does not dry powder or flake—a cosmetic as well as hygienic advantage. It is available either Scented or Unscented—the latter being especially useful for women who are allergic to perfumes.

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1. Gordon, E. S.: Nutritional and Vitamin Therapy in General Practice. Ed. 3. (Chicago: Year Book Publishers, Inc.) 1947, p. 343.

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fore it can be used—and he's kept his word to the Senate.

The medical profession is relieved at stalling off what it considered an attempt to inject socialized medicine into Social Security. Next year AMA and every other interested organization can state publicly how they think disability examinations should be administered.

And, most important, the socialized medicine dispute has not interfered with increased payments to 8 million or so persons who need the extra dollars.

The disability section of the Social Security law is just one of the issues the next Congress may be expected to do something about. The new Congress will have before it a number of other bills of more importance but which attracted little attention in the last months of the election-conscious Congress. Included are:

1. Federal aid to medical education. Nothing happened last session, although AMA modified its opposition more than a year ago. Now AMA favors federal construction and equipment grants, under a program specifically limited in years. An omnibus medical-dental-nursing bill came to one vote in the Senate but was defeated and sent back to committee. Under pressure from medical school deans, many state and local medical societies, and organized labor, the

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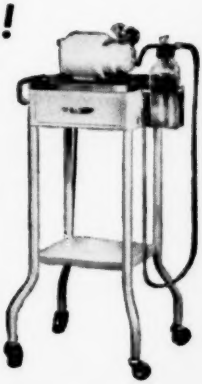

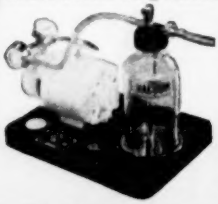

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1. Fisher, R. S. "Notes from The Office of the Chief Medical Examiner," Baltimore, Md., April, 1951.
2. Benson, R. A., et al.: "The Treatment of Ammonia Dermatitis with Diaparene," J. Ped. 34:1-49, Jan., 1949.
3. Niedelman, M. L., et al.: "Ammonia Dermatitis. Treatment with Diaparene Chloride Ointment," J. Ped. 37:5-762, Nov., 1950.

PHARMACEUTICAL DIVISION, HOMEMAKERS' PRODUCTS CORPORATION, NEW YORK 10

new Congress almost certainly will look into this field.

2. Federal aid to local public health units. In the first session of the Eighty-second Congress, the Senate passed a bill for federal help in constructing and maintaining local public health departments. It was stalled in the House Interstate and Foreign Commerce Committee on a dispute over what constitutes proper local public health services. Without question, Congress can enact a modified program to help out local health departments if a definition of services can be agreed on.

3. EMIC—emergency maternity and infant care for families of servicemen. The question here is whether there is a need. U. S. Children's Bureau, almost alone of all federal agencies and private associations, maintains that enlisted men's families need help for maternity cases. This is a program almost no one can be "against"—if a true need is shown. Congress will enact a law if a sound, cross-section survey demonstrates the need. In the final days of the last Congress, the Senate Labor and Welfare Committee, as a gesture of courtesy toward Sen. Lehman, recommended passage of such a bill, but the Senate refused to act on it.

4. National Emergency Health Insurance. Barring the election

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T.M.—Covisten

of an ultraliberal congress, this will continue to be a dead-and-buried issue for the next two years.

Washington Notes

EXTREME NEED for more services, more personnel, more facilities was the theme of the first open meetings of the President's Commission on the Health Needs of the Nation. At the sessions, panels which had met behind closed doors in the early months of the year presented their conclusions to the commission. The commission itself took no action, reserving all recommendations for its final report to be made public at the end of the year.

DEFENSE DEPARTMENT which has maintained a yes-and-no policy on financial help to enlisted men's families for medical care, now has undertaken its own survey of the problem. The services themselves are committed to extending military medical care to the families, but the Defense Department is holding back for budgetary reasons.

VETERANS ADMINISTRATION claims that its own economies have saved about $40 million in medical care during the last four years. However, VA's medical budget during the period has increased from $588 million to about $703 million.

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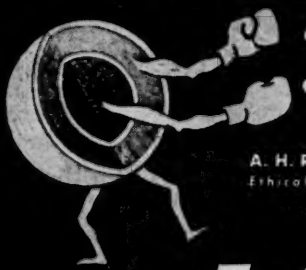

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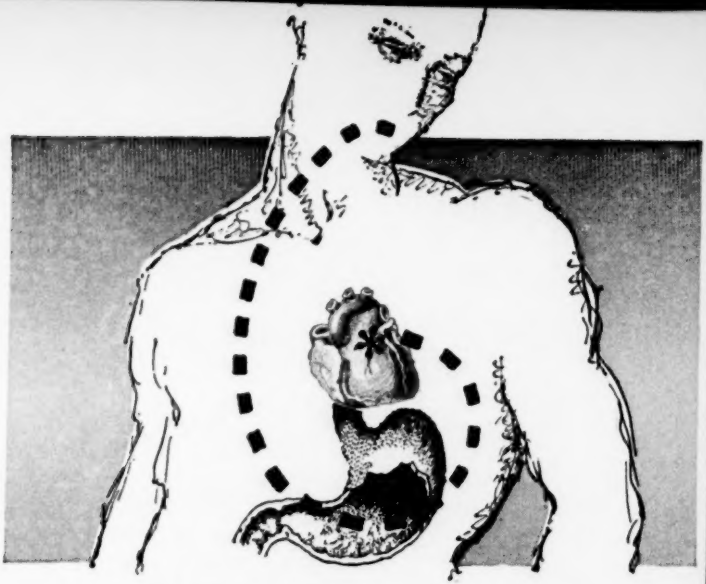

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. . . *if he takes a digitalis preparation,* because such medication is usually taken *by mouth.*

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Symposium on Trauma

Foreword

ROBERT H. KENNEDY, M.D.*
New York City

ALL practitioners of medicine, whatever their field, meet the problems of injury more or less frequently. Preventive medicine, new medications, and changing ideas have altered the character of practice and even the number of specialists required in some fields. Undoubtedly at sometime a method of arresting cancer will be found which does not entail gross destruction by surgery or radiation. We might even see the practical elimination of infections. But trauma, with all its problems, will be with us until only the last man survives.

The injured are usually treated first by the general practitioner and he also cares for most of these patients until recovery. This is as it should be, but means that new concepts must be publicized often for wide use. Further, only by appreciating how the best results may be obtained can the general practitioner learn when early referral to a specialist may mean saving life or limb or preventing other permanent disability.

The National Safety Council reports that 93,000 persons were killed in accidents in the United States during 1951 and that 9,100,000 more were injured. The site of occurrence of these accidents was, in general figures, as follows:

Home accidents	4,000,000
Public nonoccupational, nonmotor vehicle accidents (disasters, trains, airplanes, shooting, etc.)	2,000,000
Occupational accidents	2,000,000
Motor accidents	1,300,000

The estimated economic loss from these accidents was eight billion dollars, of which the medical cost was about one-half

*Professor of Clinical Surgery, New York University Post-Graduate Medical School, and Surgical Director at Beekman-Downtown Hospital, New York City.

billion. Of every 17 persons in the United States, 1 suffered a disabling injury in 1951.

Among the causes of home injuries, falls are most common, burns next, followed by suffocation and poisoning. In industry, handling objects was the source of compensable injury in 1 of 5 instances, followed in order by falls, machinery accidents, and falling objects. Machinery was the most common cause of permanent partial disability, responsible for one-third of all cases.

According to J. H. Powers, farming leads all other major industries in the number of fatal accidents. The accident rate for miners and construction and transportation workers is dropping while the rate for farmers is constantly increasing. The farmer has to be a jack-of-all trades often without special training. It is estimated that at least twenty million working days a year are lost as a result of farm accidents. In the East the barn and barnyard are the most dangerous areas, in the West the tractor is the largest single cause of accidents.

From all causes, 250,000 permanent disability cases are added to our population each year. By more effective early or definitive care many of these could be prevented.

Comparatively little time is devoted to instruction in trauma in medical schools, the usually slight attention varying in different departments according to the interest of the instructor. Trauma is not a department itself and should not be, for the problem cuts across every field of medicine just as cancer does. I hope that some day there will be coordinators in the field of trauma in medical schools similar to those established by the U. S. Public Health Service for cancer.

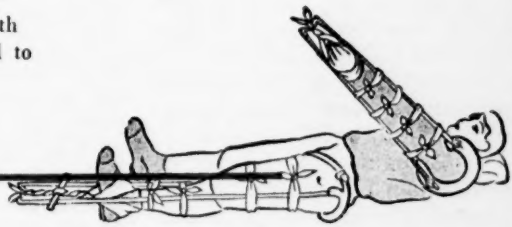
In most hospitals, even though a considerable percentage of the admissions may result from accidents, not much attention is paid to instructing the house staff in traumatic problems. The emergency room is frequently handled by the most inexperienced intern, whereas the problems arising there for immediate settlement are often the gravest. Many attending surgeons have no idea what goes on in their emergency rooms. They are losing the greatest opportunity to teach to the future practitioner the intricacies of handling asphyxia, shock, and hemorrhage. No matter how well the patient with multiple severe injuries may be handled in the operating room later, he is lucky if he ever gets there, unless instructions and procedures for early care in the emergency and radiology rooms are better than can be found in most hospitals. The interns and residents, who will

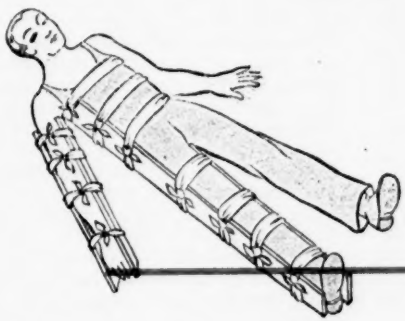
derive most of their livelihood for some years after they are in practice by treating injured people, need guidance in such efforts more than in complicated surgical procedures.

Today, postgraduate education has largely to fill the bill for training in the care of the injured. Therefore, the following symposium is being presented. We hope that it will prove valuable in saving life, in preventing many permanent disabilities, in shortening morbidity, and in making many people more comfortable during recovery from injury.

Transportation Splints (see page 68)

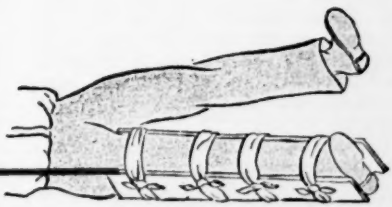
Metal splint with traction applied to arm and leg





Board splints for arm and above-the-knee fractures

Board splints for injuries to the lower extremity only



Prepared for Modern Medicine

Transportation of Accident Victims

ROSCOE C. WEBB, M.D.*
University of Minnesota, Minneapolis

IN order to arouse the personal interest of the medical profession, the question is often asked, "If you were the victim of an accident in your home community and received a fracture of the thigh or leg, would you get approved first aid and transportation to a hospital?" Too often the answer is in the negative whether the physician interrogated is from a large metropolitan city or a small community.

The Committee on Trauma of the American College of Surgeons has annually been investigating first aid and transportation of the injured in five cities. Thus far the committee has found conditions shockingly chaotic. The late Dr. William Darrach, Professor of Surgery at Columbia University, described the kind of care one might get in the following words:

The injuries resulting from fractures are not limited to those occurring at the time of the accident. Unwise attempts to use the injured extremity may cause or increase displacement of fragments, increase the lacerations of soft parts, and perhaps lead to penetration of the skin by the ends of the bone. Similar additional trauma is often due to the awkward efforts of the bystander. A man is struck by an automobile, thus breaking his leg.

Except for the broken bone, without displacement, the original injury may be merely a slight periosteal tear and a mild contusion of the soft parts, but he is helped to his feet and the leg gives way and the fragments slide by each other, thus stripping off the periosteum and tearing the muscles. He falls to the ground only to be picked up and carried to the sidewalk with the leg dangling. Larger blood vessels are torn and the end of the bone comes through the fascia, perhaps the skin and even the trouser. He is laid at rest with a coat beneath his head and surrounded by people anxious to help. Someone sees that his leg is crooked and straightens it out. The exposed end of the bone enters the wound with a bit of trouser and the dirt of the street. He is lifted up and carried to a car or ambulance. This time someone carries the injured leg with better intentions than coordination and the ends of the bone are churned around in their bed of lacerated tissues and the contaminating organisms are well disseminated throughout the area. During his ride and in the transfer to the accident ward or the doctor's office, unless he has been carefully splinted, there is more jolting and more damage. Would that his troubles were over, but too often the sad story continues. Lack of sufficient protection as he is lifted to and from the X-ray table and as he is being anesthetized results in still more injury.

Compare this exaggerated picture with a similarly injured man who is allowed to remain where he is until a proper splint can be applied, or at least until he can have someone pull hard on his foot as he is being lifted and carried, whose examination is thoroughly but gently carried out, and whose treatment is instituted with but

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little additional injury. The difference in these two cases as regards period of disability and amount of permanent functional disturbance is great.

During World War I, transportation splints were developed for the lower extremity by Keller and Blake; for the upper extremity by Murray and Jones. These splints were improvements on traditional methods because they permitted the application of traction as well as splinting. Hospitals should have standard transportation splints for exchange with local ambulances.

There has been a widespread effort to insure better transportation of accident victims by teaching Boy and Girl Scouts, Red Cross first-aid groups, and industrial safety teams as well as other similar groups. Medical schools are teaching students the scientific reasons for improved transportation methods so that when called upon the graduates may instruct lay groups.

Several cities have adopted ordinances for regulation of ambulance services. Typically the ordinance specifies minimum equipment to be carried and minimum training of personnel in first aid and application of splints, and sets forth penalties for noncompliance. Physicians can insure better transportation for the victims of traumatic injury by obtaining the adoption of such ordinances, generally.

A MODEL AMBULANCE ORDINANCE

ADOPTED BY MINNEAPOLIS

Regulating public and private ambulances, operated in the City of Minneapolis; providing for minimum equipment of such ambulances and first aid service therein; prohibiting operation without a permit from the Commissioner of Health, and providing penalties for violation thereof.

The City Council of the City of Minneapolis do ordain as follows:

Section 1. No person, firm or corporation shall operate or cause to be operated in the City of Minneapolis any ambulance, public or private, or any other vehicle commonly used for the transportation or conveyance of the sick or injured, without first securing a permit therefor from the Commissioner of Health as hereinafter provided.

Section 2. Every ambulance or vehicle hereinafter described, before permit is issued therefor, shall be equipped with and, when in service, carry as minimum equipment the following:

(a) Two United States Army hinged ring upper extremity splints, or in lieu thereof, two splints for the upper extremity, approved by the State Department of Health.

(b) Two United States Army hinged half-ring lower extremity splints, or in lieu thereof, two lower extremity splints, approved by the State Department of Health.

Section 3. Every such ambulance or vehicle hereinabove described when in service shall be accompanied by at least one person who has acquired theoretical or practical knowledge in first aid as ambulance attendant and in the application and use of approved splints to arm and leg fractures, evidenced by a certificate issued to such person by the State Department of Health or by the Commissioner of Health of the City of Minneapolis, under such rules and regulations as either may prescribe.

Section 4. Application for a permit to operate any such ambulance or other vehicle hereinabove described on the streets of Minneapolis shall be made to the Commissioner of Health upon such form as he shall prescribe, which application shall contain evidence satisfactory to the Commissioner of Health that the person seeking the permit has complied with the minimum standards set forth in this ordinance as to first aid equipment and is prepared to and will furnish an ambulance attendant, as required in Section 3 hereof. If the Commissioner of Health finds that the requirements of this ordinance are and will be met by the applicant as to each vehicle proposed to be operated, he shall issue a permit, upon payment of a fee of One Dollar ($1.00) for each vehicle, which permit shall expire upon the first Monday in May next following the issuance thereof. Such permit may be renewed by the Commissioner of Health from year to year, upon such evidence as shall be required by the Commissioner of Health that the holder thereof is complying with the minimum requirements of this ordinance and upon payment of an annual fee of One Dollar ($1.00). No fee shall be required for a permit for an ambulance or vehicle owned and operated by the City of Minneapolis or any of its boards or departments.

Each permit shall be numbered and posted at such place in the interior of the ambulance or vehicle as the Commissioner of Health may require.

Any such permit shall be subject to revocation by the Commissioner of Health for failure to comply with any of the provisions hereof, upon notice and an opportunity to be heard.

Section 5. Any person violating the provisions of this ordinance shall, upon conviction thereof, be punished by a fine of not to exceed One Hundred Dollars ($100.00), or by imprisonment for not more than ninety (90) days.

Section 6. This ordinance shall take effect and be in force from and after the first Monday in May, 1942; provided, that applications for a permit hereunder may be made prior to said day, after the passage and publication hereof, for a permit beginning upon said first Monday in May.

Passed April 24, 1942. W. Glen Wallace, President of the Council.

Approved April 24, 1942. Marvin L. Kline, Mayor.

Attest: Chas. C. Swanson, City Clerk.

To get an ambulance ordinance passed it is first necessary to obtain the official support of the local medical society. One objection which must be overcome is the claim that the applying of splints by lay persons and ambulance attendants is an invasion of the practice of medicine. An objection also may be offered because of the problem of open fractures, previously called compound fractures.

Open fractures in war are usually produced by a missile which enters and fractures the bone. It is obvious that such contaminated wounds are much better off if the contamination is prevented from spreading; a traction splint is therefore desirable. Open fractures in which the bone end has penetrated the skin and has then withdrawn to the inside are similarly contaminated and require the same protection.

In a small percentage of patients with open fractures, the bone is protruding after injury. If traction is applied, the bone end will recede and carry in contamination. However, such a patient is already contaminated inside as well as out and is going to require cleansing in the operating room. It is best to apply traction splints and protective dressings and prevent further spreading of inside contamination and further damage to the soft parts.

If we refuse to accept traction splints for open fractures because of possible objections in the last type of case we will lose the benefit which might be obtained for the first and second groups. The theoretic objections in the third group are met by thorough cleansing in the operating room.

In fractures of the hip, a traction splint properly applied against the tuberosity of the ischium may be a factor in preventing nonunion and failure in treatment.

The next step in obtaining the passage of such an ordinance is to educate those who operate the ambulances, public and private. Much ground work has been laid with these organizations, and when they find that the medical profession is interested in helping them with the practical applications of modern methods they will adopt the plan and will offer no objection to the ordinance.

After the ambulance organizations have become equipped with transportation splints and the attendants have learned how to apply them, other improved methods naturally follow. Suspected compression fractures of the dorsal and lumbar vertebra are carried in hyperextension or on a solid surface. Collar splints for neck fractures are carried on the ambulances. Some ambulances may carry oxygen and plasma as further refinements are added.

Prepared for Modern Medicine

Diagnosis and Treatment of Wound Shock

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THE shock associated with traumatic injuries, in the majority of instances, is due to blood loss.

Neurogenic and toxic factors from bacteria, necrotic tissue, or anoxia of the liver may complicate the picture; nevertheless, the administration of whole blood will usually abolish the signs and symptoms of shock within the first few hours after injury. Essential features in treatment are hemostasis, estimation of blood loss, and replacement of the blood lost.

EVALUATION

When the wounded individual is first seen, a rapid examination of the entire body should be made to determine the nature and extent of the injuries.

A shock-like state can be produced by certain cranial injuries, by respiratory obstruction, or by cardiorespiratory embarrassment. A small hemorrhage in a vital part of the brain may produce the picture of shock, but certainly all cranial injuries do not. Foreign bodies, mucus or blood in the respiratory tract, or cardiorespiratory embarrassment by cardiac tamponade, hemothorax, pneumothorax, hemopneumothorax, sucking wounds of the chest, or flail chest will produce profound shock.

In other types of injury often associated with a shock state, the loss of blood plasma will exceed the loss of whole blood as in burns, crushing injuries, peritonitis, gas gangrene, and other severe wound infections. The shock associated with some of these injuries is best treated with plasma, though frequently some whole blood is also required.

DIAGNOSIS

How does one establish the diagnosis of the syndrome called shock? There are no practical, absolute laboratory aids. The blood volume determination, the most useful laboratory aid, is not a practical procedure in emergencies. The hemoglobin level is not an accurate index of the amount of blood lost.

The best means of establishing the diagnosis in ordinary circumstances is by history and physical examination. When the *systolic blood pressure is below 100, the pulse 100 or above, the pulse volume poor, the face pale, and the extremities cool,* there can be no doubt that shock exists. When these signs and symptoms are present,

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the *blood volume has been reduced to or below 70% of normal.* Sweating, nausea, vomiting, restlessness, apprehension, and apathy may or may not be present. Marked thirst is usually a sign of a very extensive hemorrhage.

The absolute diagnosis of shock by signs and symptoms alone before the blood volume has been reduced to 70% of normal is difficult to make. Grant and Reeve have described a number of "circulatory patterns" observed after injury of the extremities among 230 civilian and military persons (Table 1).

TABLE 1. CIRCULATORY PATTERNS

Circulatory pattern	*Systolic blood pressure (normal 100-140)*	*Pulse (normal 70-99)*	*Temperature of extremities*	*Color of face*	*Blood vol. % of normal*
COLD TACHYCARDIA	Normal	Fast	Cold	Pale	70 to 80
WARM TACHYCARDIA	Normal	Fast	Warm	Full to pale	70+
HYPERTENSION	High	Slow	Warm or cold	Full to pale	80+
VASOVAGAL REACTION	Low	Slow	Cold	Pale	—
WARM HYPOTENSION	Low	Fast	Warm	Full to pale	70+
COLD HYPOTENSION	Low	Fast	Cold	Pale	70—

The circulatory pattern which they describe as cold hypotension is the pattern of unquestionable wound shock. The variable signs and symptoms when the blood volume is above 70% of normal emphasize the difficulty in diagnosing shock in the incipient stages by such factors. The difficulties are compounded when the mechanisms which produce the vasovagal reaction and those which produce shock coexist in the same person.

In addition, the patient must be evaluated in the light of sensory and emotional stimuli, exposure to heat or cold, age, and general condition before injury. Malnutrition, anemia, dehydration, and physical and mental exhaustion predispose to the development of shock. Previous inadequate transfusions, especially transfusion reactions, pro-

duce variable changes in the signs and symptoms of shock.

Apparently, then, an estimate of the amount of blood lost would be the best method of anticipating shock. Such an estimate can be made. On the basis of the estimate, the amount of blood required to relieve the signs and symptoms of shock can be judged, as well as the amount required to prepare the patient for extensive surgery.

BLOOD LOSS ESTIMATION

Surprisingly good estimates can be made on the basis of the history and physical examination. The number of hours elapsed since injury, whether bleeding has continued during that time, the degree of blood-staining of the clothes, the amount of blood in the first-aid dressings, and the descriptions of the bleeding by the patient and witnesses are all to be considered. The physician who thinks that all laymen tend to exaggerate the amount of blood loss should remember that the surgeon at the operating table frequently underestimates blood loss by as much as two-thirds of the measured amount.

The loss may not be obvious, for large quantities may be lost into the body cavities. From 2,000 to 3,000 cc. of blood may be lost into the tissues surrounding a single closed fracture of the femur. The average loss into the tissues is 800 to 1,200 cc. of blood for each closed fracture of the femur.

Grant and Reeve were able to estimate the blood loss surprisingly well in injuries of the extremities on the basis of the amount of remaining damaged tissue. The estimates were made in terms of the volume of the patient's hand (Table 2). Completely amputated parts were not included in their estimates. Abrasions, ecchymosis, broken bones, marked swelling, lacerations, discoloration, and loss of contractility of muscle were considered evidences of tissue injury.

TABLE 2. BLOOD LOSS ESTIMATION

Size of wound	*Equivalent in "hand volumes" of damaged tissue*	*Measured blood vol., % of normal*
Small	Less than 1	90
Medium	1 to 3	60 to 80
Large	3 to 5	60
Very large	More than 5	50

When the systolic blood pressure is less than 100 and the symptoms and signs of shock are present, the blood volume can be considered to be reduced to less than 70% of normal. When the blood pressure is less than 85, the blood volume is usually less than 60% of normal; 25% of the normal blood volume may be lost without producing any of the signs and symptoms of shock in some individuals.

WOUND SHOCK THERAPY

Hemorrhage—The first step in the treatment of wound shock is to stop hemorrhage. Although he-

mostasis seems such an obvious step, the experiences of World War II and in Korea demand that this point be repeatedly emphasized.

Sedation and analgesics—Morphine should be administered only for the relief of pain and apprehension. Some wounded individuals have little pain and may not be apprehensive. Only one-quarter of the severely wounded at Anzio said that they had enough pain to want pain relief medication.

Morphine administered unnecessarily may do harm. Even in moderate doses, morphine frequently produces hypotension, sweating, nausea, and vomiting in uninjured healthy young individuals. Beecher has emphasized that the safe maximum analgesic effect of morphine can be produced by 8 mg. (⅛ gr.); 15 mg. (¼ gr.) does not produce an increased analgesic effect and may cause serious depression in individuals whose tolerance has been decreased by the effects of wounds. Beecher also points out that considerable relief of pain may be obtained by the intravenous injection of 90 mg. (1.5 gr.) of pentobarbital sodium and that frequently a greater degree of pain relief can be obtained with the combination of a small dose of morphine and a small dose of pentobarbital than with large doses of either agent alone.

In the presence of the peripheral circulatory failure of shock, morphine administered hypodermically may not be absorbed into the circulation. When the peripheral circulation is reestablished repeated unabsorbed doses may be rapidly absorbed to produce an overwhelming cumulative effect. Morphine in the usual doses can be administered slowly intravenously to those who require it and who have peripheral circulatory failure.

Splinting—The wounded parts should be adequately splinted, if possible. Immobilization will help to prevent pain, hemorrhage, and more damage to tissues.

Position—The patient should have the foot of the bed elevated and the head down. The development of hypotension when the patient is placed in the supine position or with head elevated is an indication of inadequate treatment of shock.

Temperature—Neither heat nor cold should be applied if the patient is kept at ordinary room temperatures. Although the application of heat has been common practice, its use except to warm the individual to normal body temperature and prevent undue exposure to cold should be condemned. Excessive heat leads to vasodilatation and loss of fluids by perspiration, both of which augment the shock state.

Adrenal replacement therapy—At the present time there is no direct and confirmed evidence to show that cortisone, desoxycorticosterone, or adrenal cortical extract is useful in the treatment of shock. There appears to be no indication for the administration of ACTH to a patient with wound shock, for the patient's adrenal glands are apparently already maximally stimulated. The patient who had previous adrenal insufficiency (Addison's disease) should, of course, receive adrenal

replacement therapy along with other measures in the treatment of shock and insufficiency.

Vasopressor substances—Time should not be wasted by administering vasopressor drugs to a patient in shock. The vascular tree has been maximally constricted in an attempt to prevent shock and, therefore, most frequently the administration of such drugs as vasoxyl, neosynephrine, epinephrine, or norepinephrine will produce no response. The vasopressor substance norepinephrine is by far the most potent of these agents.

The only excuse for the therapeutic trial of these agents might be an attempt to bridge a gap of a few minutes while blood or other substances to replace blood volume were being processed or delivered. The effect, if any, of vasopressor substances in shock is short lived, usually a matter of minutes, and the fall of blood pressure afterward may be more profound than that before the administration. Vasopressor substances may further embarrass the already oligemic kidneys and precipitate renal failure. The recent reports of the use of norepinephrine as a definitive treatment of shock are to be condemned. Other stimulants such as coramine are not useful in the treatment of shock.

Blood replacement—Since the major early physiologic disturbances in wound shock result from blood loss, the immediate and most definitive treatment is by transfusions of whole blood. In essence, the other forms of therapy, except hemostasis, are nerely adjuncts to the administration of whole blood. If the systolic blood pressure is below 100 there should be no delay, and if it is below 70 there must be no delay in the administration of whole blood.

The amount to be administered is to be judged grossly from the evidences of bleeding, the history, the size of the wound, the systolic blood pressure, and the general condition of the patient. Little will be gained from laboratory studies; however, the hemoglobin level should not be allowed to fall below 60% and should never be allowed to fall below 50% for more than a very short time. Beecher and others have demonstrated that the hemoglobin level is decreased more than the blood volume is decreased probably because the influx of protein-rich fluid into the cardiovascular tree immediately after loss of blood increases the blood volume.

TABLE 3. RESTORING BLOOD LOSS*

Initial B. V. in %	Units needed to raise B.V. to 70%		Units needed to raise B.V. to 90%	
	Blood	*Plasma*	*Blood*	*Plasma*
60	2	2	4 to 5	6
50	2 to 3	4	4 to 6	8
40	4	6	6 to 7	10

*British units: Blood ≡ 540 cc.; Plasma ≡ 450-500 cc.

Having estimated the probable blood loss, how much blood should be administered? Proportionately

larger amounts of blood are required to replace a given amount of blood loss. Grant and Reeve have shown that a unit of whole blood, nominally 540 cc., will increase the measured blood volume in the injured patient by only 430 cc. Thus 540 cc. would increase the blood volume by only 8% instead of the expected 10%.

Table 3 shows the relative amounts of blood and plasma which Grant and Reeve found necessary to raise the blood volume to 70 and 90% of normal, respectively. Restoration of the blood volume to 70% or more abolished the signs and symptoms of shock in most instances. When the blood volume was reduced to 60% of normal, an average of 1,080 cc. of blood was required to abolish the signs and symptoms. When the blood volume was 50% of normal, 1,080 to 1,620 cc. was required; when the volume was 40% of normal, 2,160 cc. was needed.

Grant and Reeve considered the restoration of the blood volume to 90% of normal satisfactory to permit the extensive operative procedures required in most of these cases. To prepare injured patients for surgery they found that when the blood volume was 60% of normal, 2,170 to 2,700 cc. of blood was necessary. When the blood volume was 50% of normal, 2,160 to 3,360 cc. was required; when the volume was 40% of normal, 3,360 to 3,780 cc. was necessary.

Rate of administration—Blood should be given rapidly enough to bring the blood pressure to low normal (100) in the shortest possible time. Often 1,000 cc. of blood is administered in ten minutes by stripping the transfusion tubing, by a positive pressure apparatus, or by multiple, 2, 3, and even 4, transfusion sets. When an injured individual needs whole blood and a No. 15-gauge needle cannot be inserted into a vein within several minutes, the physician should not hesitate to cut down to expose 1 or more veins for the administration of blood. Once the systolic blood pressure has been restored to 100, the blood needed to raise the volume from 70 to 90% can be, and probably should be, administered more leisurely. Blood is replaced during operation at the same rate at which it is lost.

The blood lost at operation must be replaced. A patient who has been in shock and has had his blood volume restored to 90% of expected normal will go into shock more readily during and after operation than will a patient who had not been in shock and who has a normal blood volume.

Since surgeons often estimate the blood loss to be about one-third of the actual amount, some method of measurement should be used. There are a number of methods of measuring blood loss at the operating table. The most practical, mainly because of simplicity, is weighing the blood-stained sponges. Since the average weight of the dry sponges is known, any increase in weight represents blood loss. Thus a 200-gm. increase in weight represents roughly 200 cc. of blood lost and absorbed by the sponges. The blood in the suction trap can be

measured. The blood loss on the towels and drapes can be roughly estimated.

WHOLE BLOOD SUBSTITUTES

When whole blood loss is the major defect, whole blood is also the therapeutic agent of choice. If one considers some of the functions of whole blood, one realizes that other substances cannot be adequate substitutes. In the treatment of wound shock, serum, plasma, plasma derivatives, and plasma volume expanders are used only when whole blood is not available. The problems of logistics—availability, storage, transportation, and sterility—frequently make it necessary to employ one of the latter substances.

The circulating blood has many known and probably many unrecognized functions. One of the more important is the oxygen-carrying capacity of the red blood cells. Severe hypoxia or anoxia can produce shock.

Frank and his collaborators have shown that "irreversible shock" from hemorrhage in dogs can be prevented by perfusing the liver with well-oxygenated blood even though the general arterial blood pressure and blood volume of the animals are identical to those of control dogs that die. It seems likely that the liver is the "trigger organ" in the production of irreversible shock after injury and that the prevention of prolonged liver anoxia is vital to the survival of the injured patient.

It has also been demonstrated that severe anoxia of the kidneys of three hours' duration will produce anuria and renal failure. Anoxia and hypoxia of the heart and brain have serious consequences which are well recognized. Unless there is respiratory embarrassment, the administration of oxygen to patients in shock is not advisable, for the patients need the mechanism, hemoglobin in red blood cells, to transport oxygen in the body. Besides their oxygen-carrying capacity, the red blood cells add to the viscosity of the blood and so help maintain blood pressure.

The white blood cells represent one of the body's defense mechanisms against infection. Platelets, of course, are necessary for the normal clotting mechanism. The serum proteins of the blood, in addition to a colloid osmotic or oncotic effect, have numerous other functions. Prothrombin, A. C. globulin, and fibrinogen are necessary for normal blood clotting. The plasma proteins are required for the transportation of lipids and of hormones. A reduction in circulating serum protein probably tends to reduce another of the body's defense mechanisms against infection because the circulating antibodies are part of the gamma globulin fraction.

Terry and associates have shown that infused plasma may serve over long periods of time as the sole source of protein nutrition in animals. Although whole blood transfusions biologically are not equal to circulating blood, especially in regard to function of the transfused white blood cells and platelets and

prothrombin activity, it is obvious that plasma, plasma derivatives, and especially plasma volume expanders are inferior for the replacement of the whole blood lost in hemorrhagic and early traumatic shock.

BLOOD DERIVATIVES

Plasma, lyophilized plasma, and serum albumin are, of course, blood derivatives and as such are not completely adequate blood substitutes. They are excellent agents for restoring plasma volume and maintaining blood pressure. Plasma alone, however, is usually not adequate to prepare a seriously wounded casualty to withstand the surgical procedures necessary and the critical postoperative period. When plasma has been administered to treat shock, blood will be required to prepare the patient for surgery. Nevertheless, the large amounts of plasma, lyophilized plasma, and serum albumin used in wartime have saved many lives.

Plasma—According to the data of Grant and Reeve, 1 unit (540 cc.) of whole blood increases the blood volume by 8% and 450 to 500 cc. of plasma increases the blood volume by only 5%. Thus the amount of plasma required to treat shock and prepare the patient for surgery is considerably greater than the amount of whole blood that would be needed (Table 3).

The most serious complication from the use of plasma has been homologous serum jaundice; be cause plasma is usually prepared from the pooled blood of not less than 8 donors, this complication is more likely to follow the administration of a unit of plasma than a unit of blood, which is usually procured from a single donor. Ultraviolet light remains the most effective means of combating the virus of homologous serum jaundice; and all plasma and lyophilized plasma prepared today are treated by ultraviolet light.

The incidence of homologous serum jaundice is estimated to be 5% following the administration of plasma although it was as high as 22% when exceedingly large pools of nonirradiated, lyophilized plasma were reconstituted and treated by ultraviolet light. The incidence of 22% becomes more significant when one realizes that only 25% of individuals inoculated with serum known to contain the virus actually develop homologous serum jaundice.

Lyophilized plasma—Because it is in the dehydrated state and does not degenerate appreciably, lyophilized plasma is more easily preserved, stocked, and shipped than liquid plasma. A disadvantage of lyophilized plasma is that it must be stored, shipped, and used with an extra container of sterile water.

Serum albumin—Serum albumin prepared as a 25% solution with a low chloride content is heated to 60° C. for ten hours to destroy the homologous serum jaundice virus. Theoretically each 100 cc. has the colloid osmotic equivalent of 500 cc. of blood; however, according to Burnett, in actual observations in the field, 1 unit (100 cc.) of serum albumin appeared equal to 1 unit of plasma (200 to 250 cc.). This

probably was due to the fact that many of the patients observed in wartime were dehydrated. Had the albumin been diluted to isotonic concentration it would probably have been more effective, but would have lost its one advantage—compactness.

EXPANDERS

A completely satisfactory plasma volume expander has not been found. Such an agent would be [1] effective, [2] retained for more than twelve hours, [3] nontoxic, [4] nonantigenic, [5] of available material, [6] inexpensive, and [7] stable.

Dextran, oxypolygelatin, polyvinylpyrrolidone, and gelatin appear to be the most satisfactory expanders at the present time and apparently can be used satisfactorily when whole blood or blood derivatives are not available. When plasma volume expanders are used it has been suggested that the blood pressure not be raised above 80 to 85 by these agents, because excessive amounts may prevent clotting, produce further bleeding, and thus dilute the blood dangerously.

Polyvinylpyrrolidone was administered to more than 500,000 patients on the Continent during World War II. Because of the fact that whole blood cannot be preserved for more than twenty-one days and because of the almost unbelievable amounts of whole blood that would be necessary for civilian atomic bomb disasters and for global warfare, plasma volume expanders must be stocked and ready and all who might be called upon to use the agents must know the advantages and disadvantages.

¶ ACRYLIC JOINT PROSTHESES of the Judet type may produce necrosis of important weight-bearing processes. Postmortem examination of a hip arthroplasty done two weeks before death was made by P. Gowans Laing, M.D., of Pembury, England, and H. Douglas Ross, M.D., of London. The prosthesis was firmly fixed to the femoral neck. No bone rarefaction was seen on a roentgenogram of the specimen. Histologic examination of the neck of the femur surrounding the prosthetic stem revealed the medullary spaces of the inner cancellous bone to be filled with comminuted fragments of bone and necrotic myeloid debris. Some osteoblastic activity was in progress. The middle zone of dense compact bone, the calcar femorale, was the site of most universal necrosis. Lacunae without osteocytes and haversian canals without vessels or with thrombosed vessels predominated this zone. The peripheral zone of trabeculated bone showed similar necrotic changes with only the most superficial bone nucleated.

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Prepared for Modern Medicine

Care of Soft Tissue Wounds

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KNOWLEDGE and observance of surgical principles involved in the care of soft tissue wounds not only make possible orderly and effective treatment under ideal conditions, but also permit safe variations and adaptations under the adverse situations of a catastrophe, with the associated stress and limitations of time, personnel, and equipment.

It is important to remember that not just a wound requires treatment but a patient with one or more wounds. The primary purpose of treatment is to save life by arresting hemorrhage, maintaining adequate respiration, preventing or controlling shock, relieving pain and anxiety, and controlling infection. To save and restore the injured part to normal function and appearance as rapidly and effectively as possible is the secondary purpose.

Wounded patients very often have multiple injuries. Some may be obvious and others obscure, such as traumatic rupture of the spleen or perforation of a hollow viscus in the absence of a penetrating wound. By means of a rapid, thorough examination of the patient, recognition of such injuries is possible. Careful inspection of wounded extremities is particularly necessary to determine extent of injury to blood vessels, nerves, bones, and tendons. When skillfully done, such examination takes only a few minutes.

Additional information may be gained from laboratory procedures, including determination of white blood cell count, differential count, red blood cell count, hematocrit and hemoglobin levels, and urinalysis. Roentgen examination is done only when the patient's general condition permits.

Knowledge of the nature and extent of multiple injuries is of great value in differentiating those injuries requiring primary consideration from those permitting delayed treatment. For example, a patient with laceration of the hip, burns of the face and hands, and crushed chest should be treated primarily for crushed chest and secondarily for burn and laceration.

The choice of the safest type of anesthetic agent, the best time for operation, and the most practical and safest operative procedure for each case is facilitated by the information gained during physical examination.

Priority is generally given to head and spinal cord injuries, intra-abdominal injuries, intrathoracic injuries, extremity wounds requiring tourniquet, and injuries associated with marked muscle devitalization.

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CONTROL OF HEMORRHAGE

Usually, application of a sterile gauze dressing with compression will arrest bleeding. Elevation of a lacerated extremity may aid in the control of hemorrhage.

If the bleeding continues, a hemostat may be applied directly to large vessels which have been lacerated, but great care must be taken not to damage adjacent nerves.

A tourniquet is applied to wounded extremities only when hemorrhage is uncontrollable by other means. When used, the tourniquet is placed as low on the limb as possible. When applied by a lay person, the need for the tourniquet should be reevaluated by the physician. Surgical treatment is expedited for cases with tourniquets.

MAINTENANCE OF RESPIRATION

An unconscious patient should be placed on the side or back with the head turned to the side whenever possible. Elevation of the foot of the bed or stretcher favors drainage of pharyngeal secretions through the side of the mouth. Obstruction of the airway by blood or secretions should be relieved promptly by aspiration. Chest wounds affecting respiration are treated at once.

CONTROL OF SHOCK

The presence and degree of shock should be determined and steps taken to combat it promptly. The debridement of wounds with removal of foreign bodies and devitalized tissue should be deferred until shock has been relieved, since patients in shock tolerate anesthesia and surgery poorly.

RELIEF OF PAIN AND ANXIETY

Pain and anxiety should be differentiated in wounded patients. For the relief of moderate or severe pain, morphine may be effective in a dosage of ⅙ to ¼ gr. when administered hypodermically. The persistence of pain after this dose may be due to poor absorption associated with shock. Larger or repeated doses should not be given intramuscularly under such conditions, but relief can be produced by the injection of ⅛ to ⅙ gr. of morphine intravenously over a period of one minute. The discontinuation of narcotics is advisable as soon as possible to avoid the danger of addiction.

For the relief of anxiety, restlessness, or apprehension, reassurance and oral administration of barbiturates such as sodium pentobarbital, ¾ to 1½ gr. for adults, or sodium phenobarbital, 1 gr., are helpful. When given subcutaneously or intravenously, these drugs may also provide relief from mild pain.

CONTROL OF INFECTION

All wounds of violence should be considered contaminated by bacteria. Since infection is largely the result of bacterial growth upon the pabulum of devitalized tissue or debris in a wound, adequate surgery is the most important means of prophylaxis.

Antisera and chemotherapeutic agents are usually employed as therapeutic adjuncts to surgery in the care of the wounded and must not be expected to take the place of prompt and efficient surgery. However, both are very useful in

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Care of Soft Tissue Wounds

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KNOWLEDGE and observance of surgical principles involved in the care of soft tissue wounds not only make possible orderly and effective treatment under ideal conditions, but also permit safe variations and adaptations under the adverse situations of a catastrophe, with the associated stress and limitations of time, personnel, and equipment.

It is important to remember that not just a wound requires treatment but a patient with one or more wounds. The primary purpose of treatment is to save life by arresting hemorrhage, maintaining adequate respiration, preventing or controlling shock, relieving pain and anxiety, and controlling infection. To save and restore the injured part to normal function and appearance as rapidly and effectively as possible is the secondary purpose.

Wounded patients very often have multiple injuries. Some may be obvious and others obscure, such as traumatic rupture of the spleen or perforation of a hollow viscus in the absence of a penetrating wound. By means of a rapid, thorough examination of the patient, recognition of such injuries is possible. Careful inspection of wounded extremities is particularly necessary to determine extent of injury to blood vessels, nerves, bones, and tendons. When skillfully done, such examination takes only a few minutes.

Additional information may be gained from laboratory procedures, including determination of white blood cell count, differential count, red blood cell count, hematocrit and hemoglobin levels, and urinalysis. Roentgen examination is done only when the patient's general condition permits.

Knowledge of the nature and extent of multiple injuries is of great value in differentiating those injuries requiring primary consideration from those permitting delayed treatment. For example, a patient with laceration of the hip, burns of the face and hands, and crushed chest should be treated primarily for crushed chest and secondarily for burn and laceration.

The choice of the safest type of anesthetic agent, the best time for operation, and the most practical and safest operative procedure for each case is facilitated by the information gained during physical examination.

Priority is generally given to head and spinal cord injuries, intra-abdominal injuries, intrathoracic injuries, extremity wounds requiring tourniquet, and injuries associated with marked muscle devitalization.

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CONTROL OF HEMORRHAGE

Usually, application of a sterile gauze dressing with compression will arrest bleeding. Elevation of a lacerated extremity may aid in the control of hemorrhage.

If the bleeding continues, a hemostat may be applied directly to large vessels which have been lacerated, but great care must be taken not to damage adjacent nerves.

A tourniquet is applied to wounded extremities only when hemorrhage is uncontrollable by other means. When used, the tourniquet is placed as low on the limb as possible. When applied by a lay person, the need for the tourniquet should be reevaluated by the physician. Surgical treatment is expedited for cases with tourniquets.

MAINTENANCE OF RESPIRATION

An unconscious patient should be placed on the side or back with the head turned to the side whenever possible. Elevation of the foot of the bed or stretcher favors drainage of pharyngeal secretions through the side of the mouth. Obstruction of the airway by blood or secretions should be relieved promptly by aspiration. Chest wounds affecting respiration are treated at once.

CONTROL OF SHOCK

The presence and degree of shock should be determined and steps taken to combat it promptly. The debridement of wounds with removal of foreign bodies and devitalized tissue should be deferred until shock has been relieved, since patients in shock tolerate anesthesia and surgery poorly.

RELIEF OF PAIN AND ANXIETY

Pain and anxiety should be differentiated in wounded patients. For the relief of moderate or severe pain, morphine may be effective in a dosage of ⅛ to ¼ gr. when administered hypodermically. The persistence of pain after this dose may be due to poor absorption associated with shock. Larger or repeated doses should not be given intramuscularly under such conditions, but relief can be produced by the injection of ⅛ to ⅙ gr. of morphine intravenously over a period of one minute. The discontinuation of narcotics is advisable as soon as possible to avoid the danger of addiction.

For the relief of anxiety, restlessness, or apprehension, reassurance and oral administration of barbiturates such as sodium pentobarbital, ¾ to 1½ gr. for adults, or sodium phenobarbital, 1 gr., are helpful. When given subcutaneously or intravenously, these drugs may also provide relief from mild pain.

CONTROL OF INFECTION

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Antisera and chemotherapeutic agents are usually employed as therapeutic adjuncts to surgery in the care of the wounded and must not be expected to take the place of prompt and efficient surgery. However, both are very useful in

attenuating, limiting, or controlling infection by residual bacteria in wounds after debridement or in a localizing infection developing in wounds of patients when surgical treatment is delayed or impossible. Experience has shown that these agents must be used properly to obtain full benefit.

Serotherapy—The only antisera of importance which are used for the prevention or control of infections in soft tissue wounds are tetanus antitoxin and polyvalent gas gangrene antitoxin (see page 87).

Chemotherapy—In general, antibiotic agents have superseded the sulfonamides in prophylaxis and therapy of infections in patients with acute soft tissue wounds. Selection of the agent depends largely upon probable contaminating bacteria and location and nature of the wound (see page 89). Under disaster conditions, selection of the antibiotic agent may depend upon supplies, personnel, and facilities which are available.

Chemotherapy for prophylaxis should be started promptly in patients with major open wounds of soft tissues and continued for five days.

For those with injuries of moderate severity who are able to take medication by mouth, Chloromycetin, terramycin, or aureomycin in doses of 500 mg. every four to six hours may be used.

For all patients with serious injuries, the parenteral injection of penicillin is indicated, providing sensitivity to the drug does not exist. Either crystalline penicillin G in doses of 50,000 to 100,000 units is injected intramuscularly every four hours or a mixture of 300,000 units of procaine and 100,000 units of crystalline penicillin G, preferably in aqueous suspension, is given by the same route every eight to twelve hours for seventy-two hours, then every twenty-four hours.

The latter preparations suspended in oil may be given satisfactorily every twenty-four hours.

In patients in whom serious or invasive infection has occurred or is anticipated, the antibiotic therapy may be modified according to probable type of infection and severity.

Surgical treatment—Prompt and adequate surgery instituted within four to six hours after injury whenever possible is the most important means of preventing the development of infection within wounds. Adequate surgery includes early debridement, removal of foreign bodies, hemostasis, preservation of the blood supply, and proper dressing of the wound. Under disaster conditions surgery is likely to be delayed and the number of established infections is apt to be proportionately higher.

For operative procedures on the wounded, general anesthesia is preferable and ether is safest. Local or regional nerve block with 1% procaine containing 3 or 4 drops of a solution of 1:1,000 adrenalin to the oz. is satisfactory in some cases but may result in sloughs when used on the digits, ears, nose, or scrotum. It is unsatisfactory and may be dangerous in drunken individuals. The use of Pentothal Sodium is generally contraindicated in seriously injured patients.

After induction of anesthesia, the first-aid dressing is removed, a sterile gauze dressing is placed in the wound, and surrounding skin is shaved and washed, using soap or detergent containing hexachlorophene when possible. The wound may be washed to remove gross dirt if indicated.

An incision is made long enough to permit careful excision of frayed or crushed skin edges and adequate exposure of all portions of the wound. No more skin is removed than absolutely necessary and production of a circular defect is avoided. Visualization of the depths of the wound is accomplished by incision of the deeper fascial layers and retraction of the muscles.

Devitalized tissue is gently excised, care being taken not to damage the regional blood supply, adjacent nerves, or other vital structures. Particles of dirt, hair, clothing, wood, glass, or metal are removed. In a large contaminated wound of soft tissue, counterincision may be necessary to provide relaxation of tissues or dependent drainage. Irrigation with normal saline facilitates additional cleansing of the open wound. All bleeding points are ligated with fine suture material. Antiseptics, antibiotics, sulfonamides, chemicals such as ether, or other foreign substances should not be instilled into the wound.

In civilian practice under the ideal conditions existing in modern hospitals, primary closure of soft tissue wounds is a correct and safe procedure if debridement has been complete, the "time lag" six hours or less, blood supply adequate, and apposition of live tissue possible without tension; otherwise the wound should be left open. In military practice generally or in civilian practice during catastrophe, primary closure is hazardous and should not be done except in wounds of the face or superficial scalp wounds to prevent retraction of the skin edges. When wounds are left open, dry, fine mesh gauze is laid smoothly but not packed in the cavity of the wound and a dry dressing applied. The use of through-and-through gauze wicks or rubber drains should be avoided.

It is highly important to dress the wounded area with 3 definite thoughts in mind:

1] Sterile dressings properly applied greatly decrease the incidence of secondary wound contamination and infection.

2] The application of moderate and uniformly applied compression over the wounded area facilitates healing.

3] Immobilization of injured soft parts provides rest for the injured tissues, aids in healing, and helps prevent infection.

Postoperatively, rest and further supportive treatment are provided as indicated. Changing of the dressing is not done unless indicated for the removal of sutures, for secondary closure, or for diagnosis of suspected development of infection, hemorrhage, or gangrene. Delayed closure may be performed when the first postoperative dressing is done on the fourth to tenth day.

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Antiseptics, Antitoxins, and Antibiotics

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IN management of wounds, the antiseptic, antitoxic, and antibiotic agents are essential adjuvants to accepted measures.

ANTISEPTICS

The two major uses of antiseptics in surgery are: [1] cleansing of body surfaces for the purpose of sharply reducing the bacterial population, and [2] destruction of bacteria for the purpose of sterilizing inanimate objects.

Cleansing of the skin—It is important in the surgery of trauma that the skin of the patient be cleansed by the best method possible. Any antiseptic reasonably tolerated on single application to the patient's skin is usually unsuitable for repeated application to the surgeon's hands.

Iodine, 1 to 2% in 70% alcohol or in aqueous solution, is of value for preparation of the skin for needle puncture or as a single application before operation; 0.1% quaternary ammonium compound in alcohol is not as effective a bactericide, but is satisfactory because of being better tolerated by intact skin. The several acridine compounds, such as Acrizane, 1:200, and organic mercurial compounds, used as tinctures, may also be employed.

The surgeon's hands present special problems. One of the most serious is the risk of dermatitis from scrubbing and from strong antiseptics. Price recommends that the surgeon wash his hands in running water for three minutes with good quality soap, with or without a soft nailbrush, as well as trim and clean the nails. The hands should then be dried with a sterile towel and, using gauze or a washcloth, washed for sixty seconds in a 70% solution of alcohol. After the alcohol wash, dry sterilized rather than boiled gloves are applied.

When repeated scrubs are necessary, a somewhat shorter lathering, using hexachlorophene compound, may be advisable. Repeated use of this compound greatly reduces the bacterial count of the hands, and the antiseptic action is believed to persist for some time. The compound may also be used on the operative field; three minutes' application is recommended. The efficacy of hexachlorophene depends upon continued use of the compound in daily scrubs in order to maintain low bacterial counts of skin surfaces.

Cleansing the hands after contact with infectious material is best accomplished by scrubbing with warm running water and soap, as

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described above. If running water is not available, bar soap or soap solution and brush in a basin of 2,000- to 3,000-cc. capacity may be used. The solution must be changed after each use. When practicable, paper towels are used, with a proper receptacle for disposal.

The idea persists in the minds of laymen and some physicians that the one essential in an abrasion or small simple lacerated wound is the killing of contaminating bacteria. Many antiseptic substances, because of tradition and habit, are still used for this purpose. No antiseptic known today is equal in effectiveness to irrigation of the wound with sterile saline solution, gentle cleansing of the surrounding area with mild soap and water, and excision of devitalized tissue.

Nearly all antiseptics, such as tincture of iodine and many commercial agents, while bactericidal in vitro for many but not all microorganisms, are less effective in the wound environment because they are irreversibly bound to protein. Furthermore, these antiseptics are toxic to tissues and therefore tend to add to the necrotic material in a wound and, because of destructive action on leukocytes, interfere with the local operation of natural defense mechanisms. The use of antiseptics in wounds has no merit, may be hazardous, and is therefore not recommended.

The local treatment of wound suppuration is never simply a problem of destroying the bacteria present. The bacteria reside not on the surface, but deep in the wound, where contact with topical agents is unlikely. With the possible exception of preparing clean granulating surfaces for skin grafting, antibiotics would appear to have eliminated the futile attempts to employ antiseptic agents against microorganisms in infected wounds.

Sterilization of clean surgical equipment—Although steam, boiling water, and dry heat sterilization are the chief methods used in surgery for the destruction of viable organisms, chemical disinfection is also employed.

Anything that can be sterilized by dry heat, steam, or boiling water should be so treated. Dishes, bedpans, urinals, rectal tubes, surgical dressings, drains, solutions, most surgical instruments, syringes, and needles can be treated satisfactorily by any of these methods.

The effectiveness of chemical sterilization will depend upon the chemical used and the strength. In many instances, the method does not insure complete sterilization because the agent is not effective against all forms of microorganisms. Failure to keep in mind the limitations of the agents used may involve certain risks.

Cutting and optical instruments, plastics, thermometers, and other appliances adversely affected by high temperatures are ordinarily sterilized by immersion in chemical solutions. An aqueous solution of benzalkonium chloride, 1:1,000, and similar quaternary ammonium compounds are used extensively for this purpose. In an emergency, any equally efficient available solution

may be substituted. Instruments are completely submerged for one hour. When instruments are needed immediately in an emergency, boiling or autoclaving is the only safe procedure.

Scalpel blades and needles are often kept in the solution when not in use. A rust inhibitor such as sodium nitrite is added. Since the antibacterial action of this compound is opposed by soap and other anionic agents, the inactivating chemical union of soap with the disinfectant must be avoided by thorough rinsing with water followed by rinsing in a 70% alcohol solution.

Strains of *Pseudomonas aeruginosa* are particularly resistant to the action of quaternary ammonium compounds and may survive contact with such fluids. Since these organisms may persist on cork stoppers, whenever possible, screw-cap bottles should be used, and the bottle containers filled before autoclaving or boiling. Quaternary ammonium compounds are not sporicidal even after eighteen hours of exposure.

Clean catheters, bougies, telescopic instruments, and the like, may also be sterilized in a pan of mercury oxycyanide solution, 1:1,000, for thirty minutes.

Catgut sutures, in tubes, are placed in sterile jars of 70% alcohol and 1% Lysol solution for twenty-four hours before use.

Contaminated instruments or dressings—The best procedure for handling soiled instruments after a septic operation is sterilization in an autoclave or in boiling water. The instruments are then washed, dried, and cared for in the usual manner. An alternative method is, before washing, to soak the instruments in a satisfactory disinfectant compound which remains active in the presence of body protein for three hours or longer. Formaldehyde solutions containing sodium tetraborate or alcohol are capable of destroying clostridial spores in the presence of blood and other organic matter.

Viral agents such as those of infectious hepatitis are resistant to heat and chemical agents, and special precautions must be taken to insure sterilization by a thorough cleansing as well as boiling or autoclaving. Needles, syringes, rubber tubing, and catheters must be specially protected, since protein coagulation by antiseptics may serve as a nidus of infection or source of pyrogens.

Contaminated dressings are best disposed of in paper bags, promptly burned. Contaminated linen is put in a clean pillow slip and autoclaved or soaked in a 5% cresol solution for one or more hours. Exposure to bright midday sunlight for several hours after washing is also beneficial.

Containers of multiple-dose solutions for parenteral injection—A multiple-dose container is hermetically sealed to permit repeated withdrawals of a portion of the contents. This means a sterile vial and rubber stopper filled with sterile material under sterile precautions. Heat-sterilized water and isotonic solutions of saline, procaine solutions, and the like, in sterile rub-

ber-capped vials, will be employed extensively in disaster conditions. Reentry into such vials may lead to dangerous contamination.

Chlorobutanol, 0.5%, phenol, or other suitable preservatives may be added. The substances added must be nontoxic and harmless in the amounts used and must not interfere with the therapeutic efficacy of the preparations.

Several compounds are available for the preservation of pharmaceutics which cannot be heat-sterilized. Esters of parahydroxybenzoic acid, for example, are added to procaine penicillin in aqueous suspension to prevent mold growth. Solutions known or suspected to be contaminated should be discarded.

Whereas intelligent use of multiple-dose containers is safe, syringes and needles should be used singly and should be carefully sterilized after each use, if the danger of transmission of hepatitis is to be avoided.

ANTITOXINS

Tetanus—One of the greatest hazards of wounds is tetanus. It is sound practice to assume that any open wound resulting from trauma is vulnerable to tetanus infection. Any such wound should be an indication for a booster dose of toxoid or prophylactic antitoxin. In the U. S. Army, active immunization with tetanus toxoid is considered effective for four years, and booster doses given at the time of injury provide a prompt increase in circulating antibodies.

The alum-precipitated toxoid is slowly released from the site of deposition and immunization is completed with 2 injections at intervals of four to six weeks. Care must be taken to inject the alum-precipitated toxoid intramuscularly, because cold abscesses follow subcutaneous administration. The fluid toxoid is more rapidly absorbed, is less apt to produce cold abscesses, and is given as a series of 3 injections at intervals of four weeks.

Passive immunization with tetanus antitoxin is less certain and less effective and lasting than active immunization. Use of tetanus antitoxin is usually limited to 2 situations: [1] treatment for clinical tetanus, and [2] occurrence of wounds or burns necessitating protection against tetanus in patients who have not been previously immunized or who have not completed initial active tetanus immunization.

In treatment for clinical tetanus, the usual recommended dosage of 1,500 units for prophylaxis within a few hours after injury is suitable for children under 12 years of age. For adults, the prophylactic dose is 3,000 units. If the patient is treated one or two days after injury, the prophylactic dosage should be increased to from 10,000 to 20,000 units. The duration of passive immunity induced thereby is five to ten days. If the wound is not clean by this time, further passive immunization is indicated.

Sensitivity tests should always precede the administration of serum. This applies equally to initial and to secondary administration of tetanus antitoxin at intervals of five to seven days.

In the instance of an incomplete initial active immunization, combined toxoid antitoxin is given. The 1-cc. dose of tetanus toxoid combines with no more than 50 units of antitoxin and is antigenic when given with antitoxin. The toxoid series of injections is completed at an appropriate interval after the first dose.

As soon as a diagnosis of tetanus is made and preliminary testing for sensitivity to horse serum has been done, tetanus antitoxin is given. Most observers agree that 50,000 to 100,000 units intravenously constitutes a dose large enough to neutralize all the unfixed or free toxin in any patient who has a chance for recovery. From 10,000 to 20,000 units intramuscularly are advisable for the following four or five days, however. When the portal of entry is known, some recommend that it be infiltrated with 10,000 units of tetanus antitoxin one hour before debridement to neutralize the toxin in the lesion and prevent its diffusion and dissemination during debridement. Appropriate antibiotic therapy is also indicated.

Gas gangrene—Various *Clostridia* are involved in the causation of clinical gas gangrene with true toxemia. Authority for the routine use of prophylactic doses of gas gangrene antitoxin arises chiefly from animal experiments and a few scattered clinical reports. Decision to use prophylactic sera is based upon injury to muscle and the circumstances under which the injury was sustained. It should be remembered that muscle tissue may permit the growth of anaerobes as a result of direct crushing injury or of diminished blood supply from arterial laceration or shock.

Thus far, effective prophylaxis in human gas gangrene has been limited to early and adequate surgery, with adjuvant penicillin or broad-spectrum antibiotics by the parenteral route. Because there is little evidence that clostridial antitoxin is useful in the prevention of gas gangrene, prophylactic employment of gas gangrene antitoxin is not recommended.

Experimental studies are now under way on possible immunization by toxoids of the *Clostridia* of gas gangrene. Once gas gangrene infection is established, serum therapy is of doubtful therapeutic value. Polyvalent clostridial antitoxin is employed for this purpose, although what constitutes adequate dosage is unknown. The rationale for its use is the lessening of "toxemic" symptoms after administration of antitoxins.

Wound diphtheria—Diphtheria infection of an open wound is always possible when large numbers of casualties are treated. The patient may die of diphtheria if this is not recognized.

Locally, a typical diphtheritic membrane of adherent fibrin forms on the surface of the wound, and the organisms of diphtheria can be identified by the usual laboratory technics. Any evidence of facial paralysis, cardiac arrhythmias, or possible Guillain-Barré syndrome should be considered as the result of diphtheria infection until otherwise proved. If not recognized

promptly and treated with diphtheria antitoxin, the severe systemic manifestations of the disease will quickly supervene. Appropriate antibiotic therapy is also indicated.

ANTIBIOTICS

The available antibiotics include penicillin, streptomycin, aureomycin, chloramphenicol, terramycin, tyrothricin, bacitracin, neomycin, and polymyxin. The principal routes of administration are parenteral, oral, and topical. Each has indications and contraindications, including toxic potentialities. Antibiotic therapy may be used prophylactically or therapeutically in the management of open wounds. When used properly, chemotherapy may decrease morbidity, limit tissue damage, and reduce mortality.

Administration of antibiotics to protect against impending bacterial infection in major wounds and burns should be begun as soon as possible and continued for five to seven days, or longer if there is danger of invasive infection. Procaine penicillin G, 300,000 units, fortified with 100,000 units of crystalline potassium or sodium penicillin G in oil, prepackaged if possible in single-dose syringes, is administered intramuscularly.

If the patient is treated twelve hours or more after injury or is in circulatory collapse, 500,000 to 1,000,000 units of crystalline potassium or sodium penicillin G are given intravenously to provide an immediate high blood level until absorption from intramuscular depots can supply adequate bacteriostatic concentrations. If the wound involves the perineal region or if the peritoneal cavity has been penetrated, 1 gm. of streptomycin intramuscularly is also given every twelve hours.

For patients who are able to take medication by mouth, chloramphenicol, aureomycin, or terramycin may be substituted in doses of 750 mg. at eight- or twelve-hour intervals, depending on the severity of the injury. Aureomycin, chloramphenicol, and terramycin by the parenteral route may be very helpful in case of profound shock when the toxic action of bacterial products is a contributing factor.

In the event of mass casualties, when delays are imminent, patients may be encountered in whom the shock state of generalized infection may be added to abnormalities caused by hemorrhage and trauma. When the degree of circulatory collapse is great, effective blood levels of these antibiotics are best achieved by the intravenous route. Recommended dosage is 1 gm. initially, followed by 0.5 to 1 gm. at twelve-hour intervals.

Invasive infection is treated as soon as discovered. Such infection may be due to hemolytic cocci, anaerobic bacilli, or combinations of these, with or without fecal coliform bacteria. Intramuscular aqueous crystalline penicillin G is the treatment of choice and should be administered in doses of 500,000 units at eight-hour intervals. When fecal contamination is a factor, 0.5 gm. of streptomycin is given concurrently with each dose of penicillin. Also effective are aureomycin, chloramphenicol, and terra-

mycin, which may be given orally in doses of 500 mg. every six hours.

In cases of gas gangrene, aureomycin or terramycin is given intravenously in doses of 1 gm. at twelve-hour intervals. As an alternative, aqueous potassium or sodium penicillin G may be administered, 1,000,000 units intramuscularly every three to four hours.

Penicillin seems to be a useful adjuvant in the management of tetanus. The recommended dose is 500,000 units intramuscularly every eight hours.

Gram-negative infections due to *Escherichia coli, Aerobacter aerogenes,* or *Bacillus proteus* are treated with oral chloramphenicol, aureomycin, or terramycin, 500 mg. every six hours, depending on the bacterial susceptibility. Polymyxin B, 2.5 mg. per kilogram of body weight, given intramuscularly daily in equal doses at eight-hour intervals, is useful against severe *Pseudomonas* infections. Procaine solution, 1%, is used as a diluent to alleviate pain from injection. Since renal and neurologic toxicity may appear, closely supervised hospital use is recommended.

Wound suppuration is commonly a mixed infection. Whenever possible, the choice of antibiotic agents should be correlated with bacterial cultures and sensitivity tests. Tyrothricin, bacitracin, neomycin, polymyxin, and other antibiotics may be useful adjuvants in eliminating susceptible bacteria from susceptible granulating surfaces. In deep-seated foci, systemically administered antibiotics have eliminated attempts to deal with bacteria by topical antibacterial agents.

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Prepared for Modern Medicine

Head Injuries

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THE fate of a patient with a head injury is often determined long before the services of a specialist can be procured.

The emergency treatment given by the physician who first sees the injured person is an important factor in the convalescence and the ultimate recovery or disability. If improperly handled initially, the patient may sustain cerebral damage that even the most skilled neurologist or neurosurgeon cannot repair.

Certainly, the majority of persons who have head injuries tend to recover spontaneously. The role of the physician usually, then, is to assist in the maintenance of the vital functions until recovery, to prevent or minimize the complications of cerebral injuries, and to avoid procedures which may hinder the convalescence. These principles seem obvious but are difficult to follow at times, because the means of sustaining vital activities are not always adequate, the signs of complications developing in an already abnormal nervous system are often confusing, and beneficial therapy is sometimes a matter of opinion.

FIRST AID

The plight of the victim of a head injury may be measurably improved by proper first aid. Unquestionably, the primary consideration is good pulmonary ventilation. Hypoxia tends to induce cerebral edema and increase cerebral hemorrhage. If no hypoxia occurs, not only are cerebral complications lessened, but pulmonary edema, which may be neurogenic, can be prevented and bleeding from scalp or other wounds is more readily controlled.

The conscious patient, once examination has established that no skeletal fractures are present, should be placed upon his back with collar and tie loosened. The unconscious patient is better in a prone position with the head turned to one side so that secretions drip out and the tongue falls away from the pharynx, freeing the air passages. A small pillow, made of clothing if necessary, is placed under the head. If the respiratory exchange is not adequate in this position, the patient may be placed upon his back with the angles of the jaw held up to improve the airway. All clothing about the neck should be loosened.

Having assured the patient of an adequate airway, attention may be turned to the arrest of hemorrhage and the dressing of wounds. A clean unused handkerchief may serve as a pad over a scalp laceration to arrest bleeding. No attempt

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to search the wound is warranted at the scene of the accident—a pad held in place by a firm bandage is usually all that is necessary to maintain hemostasis until the patient can be transported to an office, hospital, or other medical institution.

The mode of transportation is more dependent upon the severity of the injuries and state of consciousness than upon the existence of a head wound. In the absence of skeletal fractures, a conscious cooperative patient with a dressed scalp wound may be taken in a car, sitting or lying down, to the nearest hospital. A skeletal fracture or a state of unconsciousness may require stretcher conveyance in an ambulance. Irrespective of the mode of transportation, attention should be given to maintaining the patient's body temperature and the respiratory exchange.

TRAUMATIC UNCONSCIOUSNESS

If the individual has had a serious head injury, he may be unconscious or confused at the time of the initial medical examination.

Adequate pulmonary ventilation must be maintained. A sucker to remove mucus is useful. An intratracheal tube may be necessary or even a tracheotomy if the airway cannot be kept patent by more conservative methods.

Bleeding from the scalp may be controlled temporarily by a pressure dressing. If shock is a complicating factor, it can generally be combated by a few hundred cubic centimeters of saline given intravenously. Rarely does the patient require blood or plasma unless there are other injuries, much blood has been lost from the scalp, or the cerebral injury is quite severe.

The neurologic status should be ascertained as early as possible. Some idea of the patient's initial condition may be obtained from witnesses of the accident. Repeated quick examinations may determine fluctuations in the state of the nervous system.

In a responsive patient, important points of the examination are state of consciousness, the visual fields, optic fundi, size of pupils and their reaction to light, external ocular movements, corneal reflexes, sensory status, the patient's ability to move the extremities, deep and superficial reflexes, and the tone of the neck musculature. If a patient is unconscious, the size of the pupils and their reactions, the corneal reflexes, the flaccidity of the limbs, and the deep reflexes may be examined. This knowledge of the neurologic status is essential for the early diagnosis of progressive intracranial bleeding.

SCALP LACERATIONS

A scalp laceration is the most common result of a head injury caused by a sharp or blunt object striking the head. Since the vessels of the scalp lie in loose areolar tissue between the galea and the dermal structures, which tend to pull agape, bleeding may be alarming. But, in general, scalp wounds are simple to treat and, if correctly handled, usually heal without complication. However, even the most

trivial of head wounds, if poorly and casually treated, may lead to serious complications.

To examine a laceration adequately, the hair must be clipped and the scalp shaved for several centimeters about the entire wound. Hair matted by blood may conceal a second wound. In men, if the wound is extensive, it is wise to clip the entire head; in women, only sufficient hair need be removed to give a good exposure of the wound. Loose hairs in the field may be removed easily by pressing the sticky side of a piece of adhesive tape on the scalp about the laceration.

Inspection will then enable the physician to decide if the injury is superficial, or deep and perhaps complicated by a skull fracture, and whether the laceration can be readily repaired or if a relaxing incision or a plastic procedure is necessary. An uncomplicated, small scalp wound may be cleansed, debrided, and sutured at the office or in the emergency room of the hospital. But if the scalp wound appears to be large or to involve the dura mater or brain or is associated with other injuries or with a state of shock, surgical treatment is best deferred until an operating room, a skilled neurosurgeon, and an anesthetist are available and the patient's general condition has improved.

If by inspection or palpation a fracture of the skull is suspected, roentgenograms of the head should be made. The presence of a depressed skull fracture in either a closed or open head wound necessitates a major craniotomy, which should be performed only when conditions are adequate for that type of surgery.

If a delay seems advisable, the wound may be covered with a sterile dressing, the patient given 300,000 units of a slowly absorbed penicillin compound, and general measures to combat shock instituted. Even though the patient's general condition is satisfactory, it may be advisable to postpone definitive therapy. Since many head wounds occur in the middle of the night when roentgenologic and operating facilities are not the best, extensive debridement and scalp suture are sometimes postponed until morning when adequate roentgenograms may be made and an operating team is available. This is particularly true if the patient is confused and would cooperate poorly in an extensive and long surgical procedure with local anesthesia. With the use of antibiotic agents, a delay up to forty-eight hours does not prevent debridement and primary closure.

Small linear wounds of the scalp require little more than cleansing of the area with soap and water, swabbing with a solution of Zephiran, and the application of a small sterile dressing. The decision as to whether the wound should be sutured depends upon the extent, the condition of the edges, and the amount of bleeding. If the bleeding is profuse or the wound edges are agape or much contused, the laceration should be sutured so that healing by primary intention will occur. Necrotic tissue or clotted

blood between the margins of the wound enhances the hazard of infection. A simple, effective dressing for minor wounds is a small amount of cotton put over the wound and held by colloidin on the margins.

If debridement is necessary, the first essential is a good exposure obtained by shaving the scalp. After cleansing the field with a germicidal soap and water and by swabbing with ether, the area should be scrubbed with Zephiran solution and draped. Procaine in 1% solution infiltrated from the normal scalp along the margins of the laceration will decrease the pain of the subsequent surgical procedure.

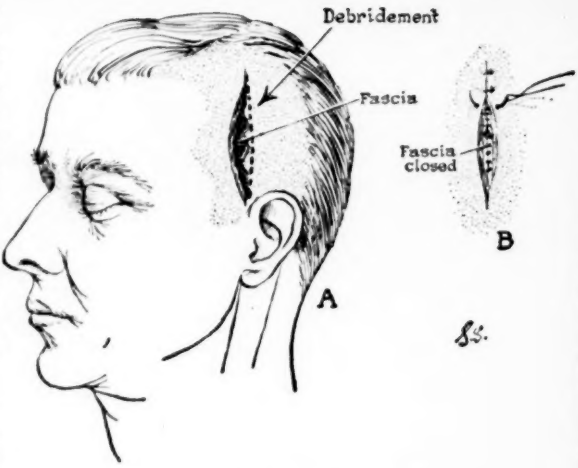

Fig. 1. Debridement and suture

The wound may then be washed out thoroughly with saline and all bleeding points caught with a hemostat. If bleeding is not stopped, adequate inspection cannot be made of the depths of the wound where foreign particles may lodge concealed by oozing blood.

The contused margins are excised by an incision in healthy scalp and the ragged tissue is removed (Fig. 1). If the wound has not penetrated the pericranium, it is better not to incise that layer. Any exposed bone should be inspected for cracks in which dirt or hair may lodge. If such are found, the crack should be excised into clean bone by making an adjacent perforation and rongeuring the bone away (Fig. 2). The local application of sulfonamides and antibiotic agents in the wound has not proved of additional value if the antibiotic agent is given systemically.

Unless the closure has been delayed for several days or the wound appears infected, it is usually best to close the scalp, without drainage, with two layers of black silk sutures, the first being placed in the galea and the second in the scalp. This will relieve the tension on the scalp sutures and allow excellent approximation. In placing the scalp sutures, correct apposition should be obtained between the two sides of the wound. If the wound crosses the hair line and eyebrow or forehead where wrinkles are prominent, the anatomic structures on the two sides should be accurately apposed to obtain a good cosmetic result (Fig. 3).

Should the patient with a minor

head injury be allowed to go home? This depends upon the amount of cerebral damage. If the asymptomatic individual has not been unconscious, or has been unconscious for only a few moments, it is usually safe to let him go home provided the relatives are warned to watch him for the next few days for headache, dizziness, mental confusion, and fever. If, however, the individual has been in coma for a longer period and is confused or complaining of headache, it is wise to keep him in the hospital for at least a day.

COMPLICATIONS

In open head injuries the most feared of complications—intracranial infection—has been greatly decreased by the systemic use of antibiotic agents for four to five days after the closure of the wound.

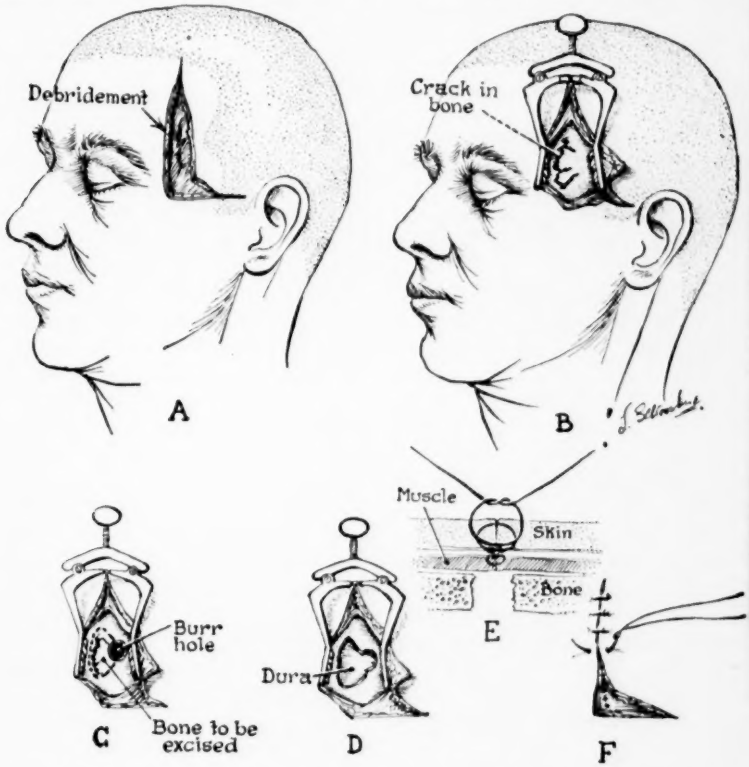

Fig. 2. After debriding the wound [A], the bone is exposed by retracting the muscle [B]. The depressed and comminuted fragments are removed by rongeuring about the margins from a perforation made in healthy bone [C, D]. The wound is closed in layers with black silk [E, F].

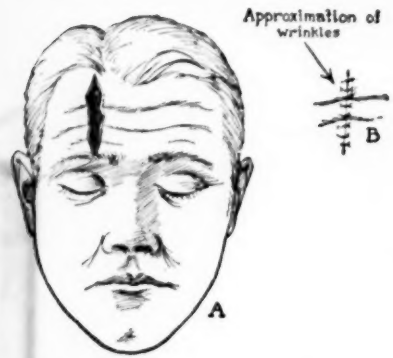

Fig. 3. Approximation of scalp margins

Such therapy is not necessary for closed head injury, unless otorrhea or rhinorrhea is present. But other complications are apt to occur in the patient with a closed head injury.

Intracranial bleeding—The interval syndrome—a lucid period after a head injury followed by progressive loss of consciousness—has been considered indicative of an extradural hematoma, but is produced by many other causes. In fact, hemorrhage is responsible for only a quarter of the cases of the lucid interval syndrome.

The chances of an extra- or subdural hemorrhage are enhanced if the focal signs of neurologic dysfunction progress. The most reliable localizing sign is dilatation of the pupil on the side of the hemorrhage. As the pupil enlarges, its reaction to light becomes more and more sluggish and weakness of the external ocular muscles may become apparent. Hemiparesis may develop, usually on the side opposite the hemorrhage, but occasionally on the side of the lesion. As the hemorrhage increases in size, the brain stem is dislocated across the midline against the tentorium, producing a state of decerebrate rigidity. At this stage the pupils are usually dilated and fixed on both sides and unless succor is afforded at once the patient dies as the result of hemorrhagic lesions in the upper part of the pons.

Unfortunately, changes in pulse rate, blood pressure, and respiration —all of which should be checked every quarter or half hour—may not correlate with progressive intracranial hypertension in cases of traumatic unconsciousness. Indications of acute cerebral compression described by earlier investigators—falling pulse and respiratory rate and a rising blood pressure—are sometimes late and inconstant findings. A rapid pulse with little alteration in blood pressure is often present in cranial injury and a slow pulse may occur without increased intracranial tension. While the triad should raise the suspicion of intracranial bleeding, its absence, in part or in whole, should not be construed to rule out such a complication. Vomiting, particularly common in children after head injury, may be evidence of cerebral compression, but often is merely a manifestation of cerebral trauma.

Although the statistical odds do not favor dural hemorrhage as the cause of the interval syndrome, that possibility cannot be eliminated without trephining the skull. If the middle meningeal artery is the source of the bleeding, decerebrate rigidity, within an hour of injury,

may herald the approach of death. In patients comatose from the time of injury, subdural hematomas are more common than extradural clots and are frequently associated with lacerated and macerated brain tissue, making the prognosis more serious.

A fracture line across the middle meningeal groove in the temporal region or a lateral displacement of a calcified pineal gland seen in roentgenograms of the skull would add further evidence in favor of a sub- or extradural hemorrhage.

The syndrome of the lucid interval is a serious emergency which often must be met by the general surgeon, for to transport a patient to a distant hospital or to call a neurosurgeon from a distance might delay decompressive therapy beyond the limit of time compatible with life. For that reason it is essential to make multiple burr holes early to search for a sub- or extradural hematoma (Fig. 4).

The primary sites are chosen to allow a general exploration of the extra- and subdural spaces. The trephinations should be made on both sides of the head if a large hematoma is not found on the first side. If extradural bleeding is not encountered, the dura mater should be carefully opened to examine the subdural space. If a clot is found it is gently washed away with saline or aspirated with a sucker. Drainage of the bed of the hematoma for twenty-four hours is usually advisable.

Under modern operating conditions this type of woodpecker surgery will do no harm. The relief of

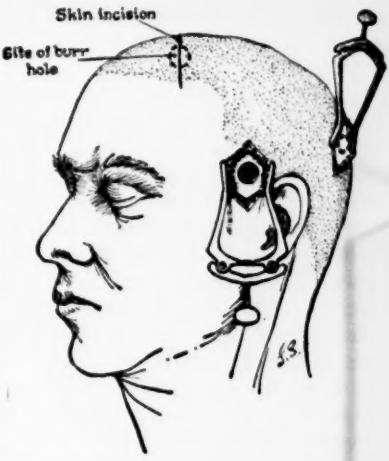

Fig. 4. Trephinations for exploration

intracranial pressure may be lifesaving.

Cerebral edema—In severe head injuries a certain degree of intracranial hypertension may be present, associated with edema of the brain. Clinically, this may be accompanied by continuing stupor and disorientation.

After eliminating as far as possible the chance that intracranial bleeding may be the cause of this hypertension, conservative methods may be tried for relief. Subtemporal decompression is no longer considered advisable nor is severe dehydration. With a better understanding of the pathogenesis of cerebral edema, emphasis is placed today upon the maintenance of adequate pulmonary oxygenation by the use of oxygen given through a nasal catheter or tent. Probably the value of antibiotic agents, which lessen the likelihood of pulmonary

infection, lies in the same mechanism.

If, in spite of these measures, cerebral edema and intracranial hypertension are present, the injection of concentrated serum albumin may be of value. Repeated lumbar puncture is worth a trial and occasionally proves efficacious. These conservative technics, with attention to fluid and electrolyte balance, are not only pleasanter for the patient but are as effective as more radical measures.

Rhinorrhea and otorrhea—Bleeding from the nose is common in head injury and usually only a manifestation of local nasal trauma, rarely requiring special attention. But in more severe head injuries, bleeding from the nose or ear may be evidence of a basal skull fracture. Cerebrospinal fluid or even brain tissue may be found in the discharge.

In most cases the otorrhea or rhinorrhea will stop spontaneously but to decrease the danger of meningeal infection, the patient should be kept flat in bed and given penicillin. The nose or ear should be kept clean by swabbing with a cotton applicator, but no attempt is made to plug the orifice, since that procedure may enhance the chance of infection spreading to the intracranial cavity. If the discharge has not ceased within a week, repair of the dural defect should be considered.

Other complications—Rarely, a head injury is complicated by such conditions as meningitis, pneumocephalus, or fat emboli, which need appropriate therapy.

SPECIAL PROCEDURES

Roentgenograms of the skull—The question of the advisability of making a roentgenogram of the skull almost always arises. With uncomplicated and satisfactorily progressing closed head injuries, roentgenograms of the skull are of little value except from the legal standpoint and can be made when the patient is convalescent and cooperative.

Emergency roentgenograms of the skull made shortly after injury, when the patient is confused, disturbed, and restless, are rarely of much value. Occasionally, if intracranial bleeding is suspected, the skull films may reveal a fracture line across the middle meningeal artery or a displaced calcified pineal gland and thus indicate the side of the lesion. In patients with extensive scalp lacerations, skull roentgenograms are much more important and should be available at the time of debridement so that the extent of depressed fractures or the presence of foreign bodies may be known.

Lumbar puncture—A diagnostic lumbar puncture is advisable in most cases of head injury to give objective evidence of the presence or absence of subarachnoid bleeding. But rarely is the tap of other worth. A normal or subnormal pressure does not eliminate the possibility of an intracranial clot, nor is an elevated pressure indicative of one, especially if the patient is restless. The amount of blood in the fluid does not correlate with the severity of injury, because serious cerebral or brain

stem contusions may be present with little subarachnoid bleeding. In some cases with pronounced restlessness or headache, considerable relief may be obtained by repeated lumbar puncture with removal of small amounts of bloody spinal fluid.

Other diagnostic procedures—Electroencephalography may be of value in assessing the course of the convalescence of a patient with a head injury but rarely is practical as an emergency diagnostic procedure. Angiography, ventriculography, and pneumoencephalography may be employed by a neurosurgeon if intracranial bleeding is believed to be complicating a head injury and exploratory burr holes do not reveal the lesion.

CONVALESCENT CARE

Once the patient has recovered from the immediate effects of a head injury and is progressing satisfactorily, some aspects of convalescent care require attention.

Diet—The patient convalescing from a head injury may be given a liquid to regular diet as tolerated. Fluids should be so regulated that 1,000 to 1,500 cc. of urine is excreted daily. If the patient is stuporous, intravenous fluids may have to be given for the first few days, and alimentation then continued by stomach tube. The formula should have adequate carbohydrate, fat, protein, minerals, and vitamins.

Restlessness—In the immediate posttraumatic period of convalescence, restlessness may be difficult to control. During the confused state a special nurse may be able to allay restlessness without drugs or mechanical restraints but the latter may be necessary if the patient is too agitated. It should not be forgotten that a distended bladder causes restlessness.

During the recovery period, sedatives may be used more freely. Paraldehyde is as effective as any drug in allaying restlessness and the taste and odor are not as obnoxious to the confused patient as to a normal individual. Barbiturates such as phenobarbital may be necessary, but morphine and other narcotics should be avoided because of depressive effects on the medullary centers.

Activity—As soon as the patient is asymptomatic, he should be encouraged to sit up and gradually increase activities. In the case of slight head injury, ambulation may be started within a day or two and, if no untoward reaction develops, the patient may be discharged to return to work in a week or so.

If the cerebral damage has been severe, the patient's recovery will be slow. Permanent damage may have been done to the brain and the individual may not be as adaptable and as intelligent as he was before the injury. For that reason it is important that patients who have had head injuries do not return to work before they are capable of coping with the situations they may encounter. Formal psychometric tests may be necessary to determine the patient's ability. Careful rehabilitation will prevent much of the posttraumatic syndrome which is so disabling.

Prepared for Modern Medicine

Initial Treatment of Ocular Trauma

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THE general practitioner should not attempt the complete management of any but the most superficial of eye injuries. He should give first aid, control infection, prevent additional trauma, and transport the patient to an ophthalmologist.

FOREIGN BODIES

Superficial—Foreign bodies which come in contact with the cornea are characterized by a sudden onset of ocular pain which is constant but intensified when blinking. In contrast, foreign body sensation caused by acute conjunctivitis is not only intermittent but is also accompanied by the usual signs of conjunctival infection.

1] *Conjunctiva*—If superficial inspection fails to reveal an obvious foreign body, the physician should look under the lid. Foreign particles on the palpebral conjunctiva are the most common form of ocular trauma. The offending matter is almost always adherent to the conjunctival surface of the upper lid, usually within 5 mm. of the border.

To expose this particle for removal, the lid should be everted. To do this, the patient is seated facing a good source of illumination with head steadied by tilting back against a wall or headrest.

While the patient is looking toward his knees, with both eyes open, the physician gently grasps the lashes in the center of the upper lid with the left hand. A wooden applicator or matchstick tightly wound with cotton and held in the right hand is used to indent the lid at the level of the superior border of the tarsal plate. While the left hand pulls the lid downward and anteriorly, pressure is applied diagonally downward and posteriorly with the applicator. The free border of the lid is then lifted upward, thus completing the eversion.

The foreign body is wiped away with a fresh applicator, moistened by saline. In rare cases the conjunctiva must be anesthetized before a firmly adherent foreign body can be removed without discomfort. If the corneal epithelium has been abraded by grating action of the foreign body, one of the ophthalmic solutions of a sulfonamide or an antibiotic should be used every two hours until healing is complete.

2] *Cornea*—Many foreign particles on the cornea can be wiped off with a moist applicator after the instillation of a local anesthetic. To prevent or minimize involuntary eye or head movements as the applicator approaches the cornea, the patient is asked to look steadily with the other eye at an object in the room and to keep *both* eyes open.

If the particle cannot be removed

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after two or three attempts, it is advisable to abandon this method, as it will cause unnecessary destruction of the epithelium surrounding the foreign body. One should then lift the embedded material from the cornea with a spud, knife point, or hypodermic needle. Ocular irritation will persist unless rust rings and all other visible particles of matter are removed.

It is not only necessary but entirely safe to remove substances embedded in the anterior half of the corneal stroma if the physician obtains complete anesthesia of the cornea, fixes the patient's head and eye, and employs adequate illumination. To achieve good instrumental control, the lids are separated with the thumb and forefinger of the left hand, the spud is held as though it were a pencil in the right hand, and the right little finger is extended and rested on the first joint of the left thumb.

A small foreign body on the apex of the cornea is often difficult to visualize, and therefore easy to overlook, because of the lack of contrast between the object and the black pupil behind. The iris can be utilized as a bright background and mirror to illuminate the particle by having the patient look up or down or to either side.

If a systematic search of the conjunctiva and cornea fails to reveal the source of trouble, an abrasion of the cornea should be suspected. If small, such abrasions are practically impossible to see until stained with a 2% solution of fluorescein. Excess staining of the face and clothing may be avoided by barely moistening the tip of a wooden applicator with fluorescein and then applying it briefly to the conjunctiva of the lower lid. A few drops of normal saline will be adequate to flush any slight excess off the intact portion of epithelium.

If a foreign body still cannot be located, a slit lamp and corneal microscope should be used before deciding that none is present.

Repeated instillations of local anesthetics will retard regrowth of the epithelium and should, therefore, not be prescribed.

Atropine is a more powerful mydriatic than necessary to prevent ciliary spasm after extraction of foreign matter from a cornea. The great majority of cases require no mydriatic, but if there is no evidence of glaucoma, a 2% solution of homatropine may be employed once. "Why use dynamite when flea powder will do?"

Because numerous studies have shown that patching an eye will increase the bacterial flora, I usually omit patches and suggest the use of dark glasses if the patient is troubled with photophobia.

Here, as with almost all types of eye trauma, the use of an ophthalmic solution of a sulfonamide or an antibiotic is indicated every two hours until the cornea has healed.

Deep—If the foreign body is lodged in the posterior half of the stroma or has penetrated the full thickness of the cornea, the eye should not be touched except by an ophthalmologist. An antibiotic solution should be liberally instilled and the patient immediately referred to an ophthalmologist.

CONTUSIONS

Lids and orbital rim—Injuries by broad blunt objects in and around the eye seldom cause a serious injury to the globe because of the excellent protection afforded by the rim of the orbit and bridge of the nose. The lids in such a case may become edematous and discolored by blood. The early application of ice compresses will tend to reduce the tissue reaction. The compresses should be applied forty-five minutes each hour for the first three hours after the trauma.

A fracture of the orbital rim can often be detected by palpation: If a sinus is involved, crepitation will be noted in the area of the fracture. If a fragment of bone is depressed, elevation is more easily done at once than if attempted later.

If the patient has periorbital, palpebral, and subconjunctival hemorrhages after a head injury, one should suspect a basilar skull fracture in the anterior fossa. Here, as with foreign bodies, lacerations, and burns, vision should be estimated and compared with that of the other eye. If a suggestion of reduction in visual acuity is found, the patient should be referred to an ophthalmologist.

Conjunctiva—Ocular contusions not infrequently lead to a traumatic conjunctivitis which responds well to cold compresses and antibiotic solutions.

Subconjunctival hemorrhages are common sequelae to eye injuries; if the remainder of the globe is normal, the only therapy the physician can offer is reassurance that the unslightly hemorrhage will clear.

Cornea—Small blunt objects, in contradistinction to large ones, can and often do cause severe ocular damage. Corneal evidence for this varies from slight abrasions of the epithelium to wrinkling of Descemet's membrane or even actual rupture of the globe.

Anterior chamber and iris—The presence of blood in the anterior chamber indicates that the eye has been severely traumatized; the patient should be seen at once by a specialist. Although the iris completely absorbs the great majority of these hemorrhages, some do not clear up, especially if the intraocular pressure becomes elevated. The question as to whether a mydriatic should be instilled is as yet unsettled by the eye specialists, so the course of wisdom for the examining physician would be to use none. The patient should be put to bed and the ophthalmologist called.

Lens, vitreous, choroid, or retina—Patients with injuries involving the lens, vitreous, choroid, or retina should be kept supine and quiet until they can be seen by an ophthalmologist.

LACERATIONS

Deep lacerations of lids—In general, deep lacerations about the orbit and eye should be repaired by a qualified specialist. The first physician to see the patient should largely concern himself with the treatment of shock and the systemic administration of an antibiotic.

If, however, the cornea is exposed, an effort should be made to cover it. If exposure is due to partial avulsion of a lid, 2 or 3 fine

sutures may serve to approximate the original position. If corneal exposure results from the complete loss of a lid, temporary protection can be quickly obtained by suturing the edge of the remaining lid to the remnants of the avulsed one.

Superficial lacerations of lids—Lacerations involving only lid skin may be closed by direct suturing with 6-zero silk on atraumatic needles. This can be neatly accomplished if the operator has the proper suture material, fine forceps, and a mosquito hemostat as a needle holder, and if he has the patience.

Ophthalmologists find that a laceration of the canaliculus is exceedingly difficult to repair accurately. These, therefore, should not be touched by one lacking in experience. The same may be said of lacerations through lid margins. Improper closure of these will often result in unsightly notching of the lid border.

Lacerations of the conjunctiva alone—Lacerations involving only the conjunctiva should be closed by small silk or plain gut sutures.

Superficial lacerations of the cornea—When the cornea is superficially lacerated, small foreign bodies should be carefully looked for and removed. Ointments should not be used because their presence in a corneal wound delays healing. Sutures are not required.

Deep lacerations of cornea or sclera—Whether or not uveal tissue is prolapsed, deep lacerations of the cornea or sclera should be referred to an ophthalmologist for treatment and closure.

BURNS

Thermal—If *lid* skin suffers more than a first-degree burn, a plastic or ophthalmic surgeon should be called in consultation. Inadequately treated second- and third-degree burns of the lids may result in keratitis from lid contraction.

The *conjunctiva* and *cornea* are very rarely damaged by thermal burns because of the speed of the protective blink reflex. If damaged, an ophthalmologist should be responsible for their treatment.

Chemical—When a chemical substance comes in contact with an eye, treatment consists of *immediate* removal by copious irrigation at the nearest water tap. The quicker the chemical is removed, the less the damage to the tissues. Valuable time, therefore, should not be wasted looking for a neutralizer or transporting the patient to a hospital until the eye has been thoroughly lavaged on the spot.

The lids should be forcibly separated to allow the stream of water to come in contact with the globe. It may be more convenient for the patient to immerse his whole head in a pail of water. After the initial irrigation, a local anesthetic will relieve blepharospasm sufficiently to permit direct removal by a swab of retained particles under the upper lid, on the cornea, or in the lower cul-de-sac. The irrigation should then be continued, whether by faucet, hose, or pail. Isotonic saline, if available in large quantities, would be preferable. Only after these measures have been taken should the patient be sent to an ophthalmologist.

Prepared for Modern Medicine

Plastic Surgery Repair of Face Injuries

JAMES BARRETT BROWN, M.D.
St. Louis

PROMPT surgical repair of open facial injuries can be of great value, relying on generally applicable surgical principles for the most part, but also utilizing precepts of treatment peculiar to the face.

Because gas gangrene is almost unknown in facial wounds, cutting debridement is rarely necessary, except for obviously dead tissue. For the same reason, even deep wounds can be closed primarily instead of being packed open.

Extensive cutting debridement is avoided in facial injuries because features must be preserved and distortion kept at an absolute minimum for physiologic and cosmetic reasons. What we have called contour anatomy is most important to maintain, since the face should be as normal looking and pleasing as possible. Primary closure of wounds without cutting debridement will yield results often unobtainable in an injury that has been packed open, despite countless later plastic repairs.

Early repair is of prime importance. Others have suggested that the repairing of facial wounds should await subsidence of swelling. However, my experience shows that surgery performed within twenty hours of an accident yields the best results. If the operation is delayed, blood clots, large and organized, are encountered, usually with infection and attendant fibrosis. Also, bony fragments tend to become fixed in faulty position, making the reparative procedure difficult.

Certain factors demand a delay of surgery. Chief among these are shock and neurologic damage from brain injury or from fractures of the skull or vertebrae. For this reason, a careful neurologic examination and roentgenograms of the skull and of the cervical spine are indicated in all but minor accidents.

FIRST MEASURES

The injured face should not be manipulated until the patient is in the operating room. After more dangerous internal injuries or fractures have been searched for and treated, work on the face is begun. First, a general evaluation of the kind and extent of injuries, including facial bone fractures, is made and recorded.

Nerve injury, especially of the seventh and second cranial nerves, is carefully tested for and, if present, noted in the record. If a particular wound is causing considerable discomfort, that is tended to first, as, for example, a symphysis fracture of the mandible. Fixation of such a fracture will facilitate the remaining repairs.

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Except with children, who ordinarily require general anesthesia, novocain is the anesthetic of choice. Local infiltration may suffice, even in children, the first injection being made through the wound to avoid fright, after a topical anesthetic has been used in the wound. For more extensive injuries, procaine nerve block, as of the maxillary and mandibular branches of the trigeminal nerve, is best.

Cleansing of the wound should be thorough, but cutting debridement is kept at a minimum since this is done at the expense of essential tissues which make up the features. The mobility of the normal face will be lost if wide cutting debridement is used. Only hopelessly devitalized tissues are removed. It is better to leave tissue that may die than to remove some that might live. There is no extra tissue in the face, eyelids, nose, or lips, especially in young persons.

Wounds are washed with soap and water or a detergent. If dirt is ground into the lacerations, scrubbing will be needed. Should oil or grease be present, careful use of a solvent or a thinner oil is helpful. Finally, the wounds are copiously flushed with saline.

LACERATIONS

In repairing lacerations, the surgeon does well to begin at some easily recognizable landmark such as the border of the lip, nostril, eyelid, or eyebrow. Angles can be used as starting points, being careful to close Y tears as Y's and V's as V's and not vice versa. Lacking a landmark, a large tear can be closed at its center and then at the center of each remaining gap. These sutures bisect each part of the defect. Closing a tear from one end to the other often leads to distortion. The operator should not hesitate to replace a row of sutures if alignment is poor.

If possible, wounds are closed with deep sutures before surface sutures are put in. No. 000 white silk or fine catgut is recommended. Stay sutures, if needed, should be placed from the inside of the cheek or nose, when feasible, to avoid scarring. If placed through skin, the stay sutures should be kept close to the wound edge and tied over a gauze sponge to avoid scarring from suture cuts. Such scars are most difficult to eradicate later and leave a permanent ladder effect in the wound, evidence that full recognition of the ideal has not been made.

Hemorrhage must be painstakingly controlled. Some wounds have to be deepened so that bleeding points may be exposed and ligated. Wound closure over bleeding deep vessels leads to distortion and impedes healing. Occasionally a stubborn bleeder can only be clamped. The hemostat is left in place for later removal. Patients have been returned to the ward with several hemostats bandaged in place.

External carotid artery ligation in the neck as a means of controlling deep facial hemorrhage is of little value and should be avoided except in occasional instances. Dependent drains are placed as indicated.

When the operative repair is com-

plete, a large fixing pressure bandage is applied. Snugly wrapped cotton surgical waste works well.

FRACTURES

So many facial injuries result from forceful blows that fractures of facial bones should always be looked for. As with lacerations, best results will be obtained by early operation. If delayed a week or longer, the setting of facial bone fractures is difficult and may be unsatisfactory because of fixation of displaced fragments.

Heavy blows to the upper face often loosen the zygoma in bulk without actually breaking the body of the bone. Fractures are common

Common upper jaw separations

at the frontal-zygomatic suture line, the glabella, and the wall of the maxillary sinus. The maxilla may be completely separated just above the dental arch. The small nasal, septal, and palatal bones are often crushed with other fractures. Care is indicated to try to preserve normal mastication with fractures involving the alveolar ridges.

As with the soft tissues, cutting debridement of shattered facial bones should be sparingly done. Later bone grafting will be more often needed if the bone chip removal is overly enthusiastic. A general rule is to replace fragments with the least manipulation and as few complicated splints and traction devices as possible.

Detailed roentgen studies should be made before the initial repair of a fresh facial injury, although most fractures which will require special attention are detectable at the time of surgery. Verticosubmental and antral views will be helpful in checking for the presence and alignment of orbital, zygomatic, and upper jaw fractures. Laminagrams may give the best information for fractures of the temporomandibular joint.

Small comminuted bones are molded back into position and held in place by gauze packs in the nose or antrum, again with care not to discard viable chips. Many fractures can be maintained by interdental wiring or other dental appliances. Mandibular fractures are often best adapted to internal wire-pin fixation. This technic is of special value for fractures at the angle of the mandible or the symphysis and when the teeth are too few to permit satisfactory interdental wiring. Incidentally, if the patient is intoxicated or vomiting, the jaws should not be wired shut.

Facial fractures, especially of thin platelike bones, may never heal by bony union. However, good function and position are attained by the fibrous bridge which forms. An important feature of mandibular fractures is that the fracture line may persist on roentgenograms despite solid bony healing; this is significant from a medicolegal aspect.

GRAFTING

A basic principle of plastic surgery is to use locally available tissue whenever possible. However, if tissue loss is great, autogenous grafts must be employed. The best source of skin for facial grafting is the supraclavicular area. The cutis in this region has a "face-like" texture and provides thick grafts of adequate mobility and proper color. Another source is the skin behind the ear, but both these areas are of limited extent.

Skin grafts are frequently needed after face burns. Free skin grafts are best for flat surfaces of the face and eyelids. However, if features have been lost and their bulk must be restored and their contours molded, pedicle grafts are necessary. Burns of the male face present a special problem. The whisker follicles must be removed. Deep resection into the subcutaneous tissue is sometimes required.

Scarring after burns tends to stretch the remaining skin until features are distorted and the function of lips and eyelids is lost. The original defect often has to be recreated by surgery to relieve tension before grafting.

Bone grafts are also required when the loss has been extensive. The ribs and iliac crests provide good sources of bone for this purpose. If overlying structures are also lost, the soft tissue coverings must be restored first. The building is from outside in. Later, the bone graft is wired in place to provide its own splint. Subcutaneous prostheses of cartilage, bone, or nonirritating metal or plastic may improve the cosmetic effect.

OTHER REPAIRS

When seventh nerve paralysis occurs, the ideal treatment is nerve repair. This is often impossible, especially if treatment is delayed. The sagging caused by muscle function loss can be relieved by live strips of autogenous fascia lata. The strips are anchored in the temporal muscle and looped down in the face at the mouth and lip levels. A strip to support the lower lid may also be indicated. In long standing paralysis, extra lax tissue can be excised.

Although remarkable results may be achieved by adequate and early initial repair of a facial injury, secondary adjustments are often needed. The patient should be forewarned of this contingency. If multiple operations are necessary, the rest periods between stages must not be rushed. The best possible blood supply and healing should be allowed to develop before the next surgical step is undertaken.

Prepared for Modern Medicine

Management of Acute Neck Injuries

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AN injury to the neck is never slight enough to be neglected nor extensive enough to be regarded as hopeless.

Neck injuries vary in extent and significance from the superficial and inconsequential to the deepest, most disabling, and life endangering, yet the size of the external wound and the extent of tissue damage do not always reveal the difference between the two extremes. Many neck wounds that appear slight are immediately fatal or become so soon after injury. However, if the patient can survive long enough to receive adequate care, the severest wounds may be treated with survival of the patient.

FIRST-AID INSTRUCTIONS

1] Apply a sterile dressing of adequate size, shape, and volume to cover the wound, prevent flow of blood, and avoid further contamination.

2] Fix the dressing in place with adhesive tape or with a bandage anchored about the head, jaw, or opposite axilla.

3] Direct the patient immediately to an emergency aid room or hospital.

4] Do not tamper with the wound, remove foreign bodies, or disturb blood clots.

5] Do not apply a snug circular bandage around the neck.

A careful examination of patients with neck wounds will help to separate those who may be given necessary care at a well-equipped emergency room from those who require more adequate facilities and personnel. The latter patients must be further separated into those who require *urgent care* for respiratory obstruction or hemorrhage and those who may be given *delayed care* pending arrival at a hospital.

Answers to the following questions will help to classify the case. Does the patient have:

- Respiratory obstruction present, impending, or likely?
- Vascular injury with external or internal hemorrhage?
- Injury or likely injury to the cervical cord?
- A foreign body lodged in the neck?
- Injury to the pharynx or esophagus?
- Injury to the head above or the chest below the neck wound?
- Other injuries that require special care?

For patients whose wounds do not involve the important structures outlined above, the following treatment is used:

1] Protect the open wound with a sterile dressing while cleansing a wide surrounding area with plain soap and water. Shave hairy parts.

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2] Infiltrate the margins of the wound through the intact skin with a 1% solution of procaine.
3] Cleanse the wound and excise only devitalized tissues.
4] Close the wound with the least number of interrupted nonabsorbable sutures necessary for adequate approximation without tension.
5] Apply a sterile dressing and supporting bandage.
6] Give tetanus antitoxin or tetanus toxoid and antibiotic medication when circumstances warrant such treatment.

Note: No constricting bandage should be applied to the neck of a patient who is unconscious or who may become so after medication unless someone is in attendance to guard against strangulation from hemorrhage, edema, or any other cause of tracheal obstruction or venous compression.

In the case of a patient who requires more adequate facilities, the wound should be covered with a sterile dressing of appropriate size and the patient sent to a hospital. It may be advisable to transport the patient in a prone position if tracheal or esophageal injury makes fatal aspiration of blood secretions or vomitus possible.

Even in the well-equipped emergency room, probing of neck wounds and removal of blood clots should not be done unless one is prepared to control hemorrhage and supply blood in a volume sufficient to prevent or overcome shock. However, the urgent case must be cared for promptly.

AIR PASSAGE INJURY

Respiratory obstruction may result from aspiration of blood or a foreign body; direct trauma to the larynx or trachea; edema following injuries to adjacent structures in the neck or floor of the mouth; and increased pressure in the neck from hemorrhage.

Respiratory obstruction, impending or likely, warrants immediate hospitalization lest an urgent condition be precipitated. Morphine should not be given to a patient with impending obstruction.

When strangulation is present or developing, immediate tracheotomy is necessary. Done soon enough, even under the most unfavorable circumstances, the procedure may be lifesaving. Inspiratory indrawing at the suprasternal notch, supraclavicular fossae, and epigastrium indicates urgency.

The preparation of the skin for tracheotomy is done as in any elective procedure, but the urgency of the situation may curtail some or all of the steps that are commonly taken.

1] The trachea is fixed between the thumb and index finger.
2] Skin incision is made over the trachea. A longitudinal incision in the midline of the neck is the most expedient.
3] Fascia is separated in the midline.
4] Incision is made into 2 tracheal rings, at least 2 rings below the cricoid cartilage.
5] A tube of metal, rubber, or glass, whichever available, is inserted. Needed instruments—a forceps, bent hairpin, pa-

Neck Incisions

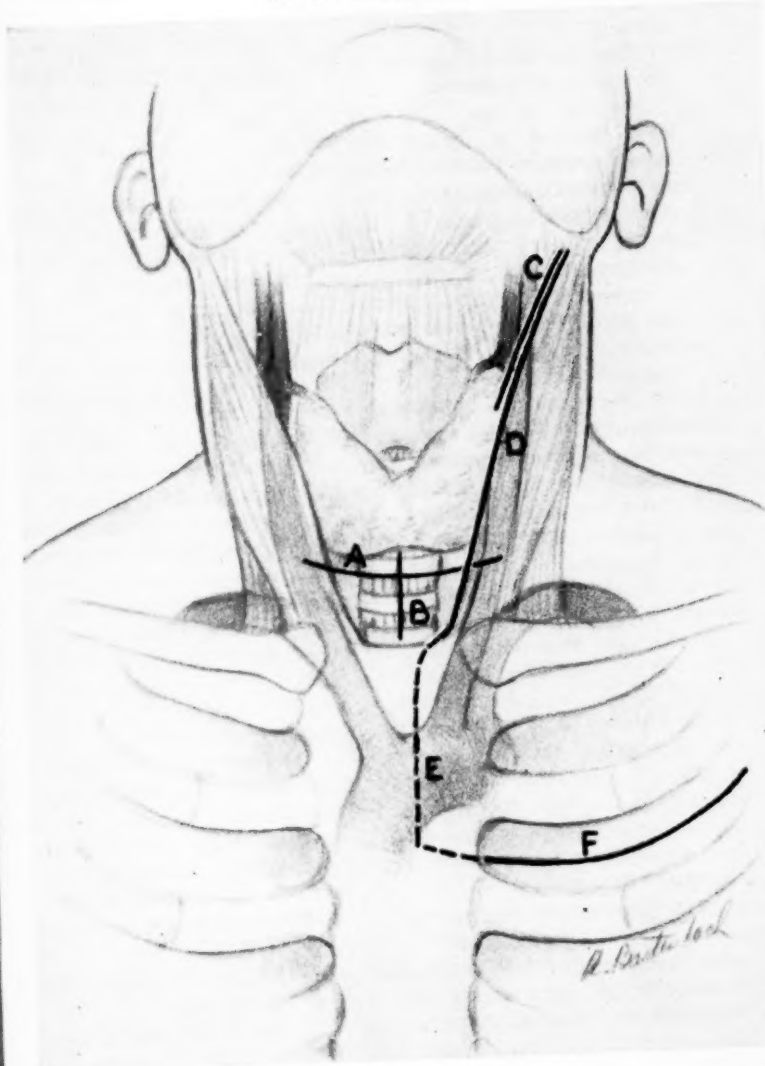

Figure 1

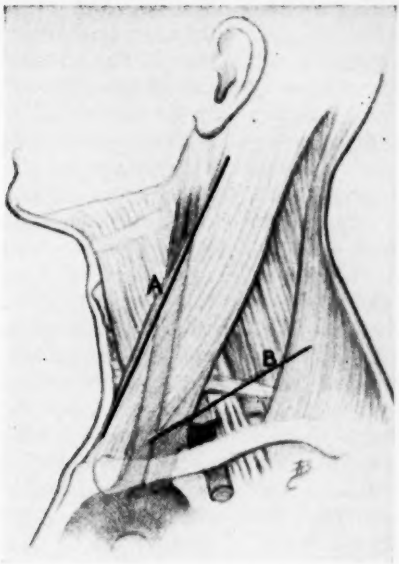

Figure 2

Ample exposure of the important structures in the neck is afforded by the incisions indicated in the illustrations. One of the principles in the management of a wound in a large artery is exposure of the vessel proximal to the site of injury.

Fig. 1. The innominate, left carotid, and left subclavian arteries as they leave the arch of the aorta may be exposed through the second interspace. Through a right-sided approach, the right carotid, first part of the right subclavian, and the innominate arteries may be exposed. Through a left-sided approach [F] the left carotid, first part of the left subclavian, and the innominate arteries may be exposed. Tracheotomy through an elective incision [A] is desirable but a longitudinal incision longer than illustrated is useful in an urgent situation. Incision [D] gives a wide exposure of the neck structures, which may be extended down across the sternum [E] to become continuous with [F] if wider exposure at the root of the neck and upper mediastinum is necessary. The limited incision [C] is usually inadequate for wounds involving the pharynx or vessels in the upper neck.

Fig. 2. Incisions [A] and [B] give access to most structures on the side of the neck and in the midline. Control of bleeding in the axilla may be accomplished by control of the subclavian artery in the neck.

per clip, or other object—may have to be improvised.

6] Suction is accomplished with bulb syringe and catheter if available. Dependent position of head may aid in emptying the bronchial tree of blood or secretions and permit aeration.

7] Hospitalization is required for more definitive care.

Elective tracheotomy done under better circumstances differs from the urgent type in the following particulars:

1] Adequate skin preparation

2] Anesthesia—1% procaine infiltration along line of incision

3] Skin incision, similar to a thyroidectomy incision, at a level below the cricoid but well above the suprasternal notch

4] Fascia incised in the midline over the tracheal rings

5] Trachea exposed and incised 2 rings below the cricoid cartilage

6] Insertion of a cannula of proper size with obturator, being certain of correct fit into the trachea

7] Suction apparatus and oxygen for inhalation

8] Nursing care

Injuries to the trachea or larynx due to blunt trauma may result in edema even as late as forty-eight hours after injury. Tracheotomy may become necessary at any time. To prevent strangulation the patient must be observed by competent attendants. The gradual development of anoxia may be subtle until sudden changes prove fatal.

Penetrating or perforating wounds of the respiratory passage are usually associated with emphysema of the superficial tissues. These wounds should be exposed, cleansed, and closed but need not be closed snugly by suture. The skin should be loosely approximated lest infection develop and interfere with the healing process. Large tracheal wounds may be closed by suture or covered with adjacent muscle tissue or thyroid gland if available. It is best not to place a tracheotomy tube into a wound of the trachea, especially when close to the cricoid cartilage. When necessary, the tracheotomy tube should be inserted at the elective site in the trachea.

Tracheotomy tubes should be removed as soon as possible when the airway is patent. This can be determined by plugging the opening in the tube or by substituting a tube of smaller caliber.

When possible, the advice and services of a laryngologist should be sought to prevent the sequelae of these injuries.

VESSEL INJURY

Bleeding from superficial vessels is controlled by ligation. When injury to a large vessel is present or is suspected, manipulation of the wound should be avoided lest disturbance of a protective blood clot result in an uncontrollable hemorrhage.

Care of injuries to large vessels requires [1] blood for replacement, [2] intratracheal anesthesia, [3] oxygen, [4] adequate assistance to aid in exposure of the wound and to control the flow of blood in the carotid, innominate, or subclavian arteries, [5] suture material and

proper instruments, [6] adequate lighting, and [7] nursing care.

Unless these facilities are available, or pending transportation to a hospital, the wound should be covered with a compression dressing held by adhesive tape which does not encircle the neck or by manual compression. Control of hemorrhage in some instances is aided by suture of the skin wound for temporary hemostasis.

Penetrating or perforating wounds of small size associated with severance or perforation of large vessels may be accompanied by little or no external bleeding. The neck becomes swollen because of venous compression and extravasation of blood in the fascial spaces. This is commonly associated with difficulty in breathing, resulting partly from tracheal compression and partly from factors associated with increased pressure in the neck but not related to a decrease in size of the airway.

It is of some value to distinguish between strangulation caused by obstruction in the airway and strangulation caused by internal tension in the neck. Decompression of the fascial spaces by incision will relieve the respiratory difficulty, but the bleeding point must now be controlled lest fatal hemorrhage ensue.

In the urgent case requiring immediate care, adequate blood replacement with restoration of the blood volume to a normal level is not only desirable but imperative. Oxygenation at maximum levels is always desirable, but the most critical period is during the time of anesthesia while surgery is in progress. Anesthesia must afford a high oxygen intake.

A competent anesthetist familiar with the necessary technics and conscious of the special needs of a patient with this type of injury is a valuable asset. Local anesthesia for an elective procedure may theoretically be most desirable in avoiding the anoxia associated with general anesthesia. However, a recently injured patient, who is fully cognizant of the neck injury, especially when some dyspnea is present, is usually very anxious to be put to sleep. In addition, when the exposed wound is obscured by blood and damaged tissue, complete anesthesia with local injections of procaine may not be possible.

A seriously wounded patient should not be subjected to avoidable physical or mental pain. A struggling patient cannot cooperate, and a bleeding neck requires a deliberate and careful approach to prevent adding to the damage. In a group of successful cases it was noteworthy that almost all the patients with neck wounds involving the carotid artery were awake immediately after surgery was completed. They had had nitrous oxide-oxygen-ether anesthesia given by a competent anesthetist who used the endotracheal technic.

Surgical procedure is as follows:

1] Skin incision over the anterior border of the sternomastoid muscle on the side of the injured vessel.

2] Compression by stick sponge over site of injury.

3] Isolation of carotid artery be-

low the wound with application of tape sling.

4] Isolation of carotid artery and jugular vein above the injured site by tape slings.

5] Exposure of the injured segment of vessel. Wound cleansed of clots, loose tissue, and tags or devitalized tissue.

6] Closure of the arterial wound either by a continuous nonabsorbable suture, 0000 on needle, or ligation with a braided silk ligature. Ligations are done close to adjacent branches with removal of the damaged segment. The smaller the artery's caliber, the finer the ligature needed. Veins are ligated close to branches to avoid sacs of noncirculating blood. In injuries to the common or internal carotid, every effort should be made to apply lateral suture to avoid hemiplegia.

7] Skin is closed loosely. *No drains* are used.

8] Firm bandage is applied and adequate nursing care instituted.

9] Whole blood is given as required for replacement.

10] Antibiotics are given in effective dosage and tetanus antitoxin or toxoid is used as indicated.

11] Oxygen inhalation is necessary and desirable when any large vessel to the brain is occluded.

Note: Drains should not be placed near sutured vessels or viscera. They delay wound healing, predispose to wound infection, secondary hemorrhage, or fistula formation.

CERVICAL CORD INJURY

Penetrating and perforating neck wounds may be caused by missiles which lodge adjacent to the cervical cord. The wound may appear trivial and the patient walk into the emergency aid room only to die suddenly after manipulation of the neck.

Fractures and dislocations of the neck may be unassociated with cord injury until manipulation causes changes which result in paralysis or death. Thus, suspicion that such a sequel is possible warrants extreme care and study of the case with roentgenograms before extensive manipulations are undertaken.

FOREIGN BODIES

Cases with perforating wounds, lacerations, and superficially embedded foreign bodies obvious on inspection do not warrant immediate roentgen studies. However, penetrating wounds with the possibility of a foreign body lodged in the neck warrant roentgenograms to determine the probable course of the missile, site of lodgment, and the resulting likely damage. Two views, anteroposterior and lateral, are made. They should include the base of the skull and the clavicles. Depending upon the direction of the wound, additional studies of the skull or chest may be necessary to complete evaluation of the injury.

It is extremely important that the *left* and *right* sides be correctly marked on the films and that the examination of the neck be made

with these markings clearly in view. Missiles which enter on one side of the neck may lodge on the opposite side and do more damage at the site of lodgment than on the side of entrance. Thus, surgical care may be more urgent on the side opposite to the external wound. A misinterpretation of the film insofar as the side of lodgment of the missile is concerned may result in futile efforts to achieve benefit.

PHARYNX AND ESOPHAGUS

Injuries to the pharynx and esophagus may be noted on inspection, suspected from the course of a missile, or become obvious when complications develop. Exposure of the site of the wound with decompression of the fascial spaces or mediastinum is all that is necessary in most instances. In small wounds, healing occurs without suture, but repair of large rents is desirable to avoid persistent leakage of secretions.

Feeding through a nasal catheter may be advisable for several days, depending on the size of the opening. Extensive wounds of the pharynx or esophagus may heal better without an indwelling catheter. The establishment of a gastrostomy or jejunostomy may better accomplish maintenance of nutrition without interfering with the healing process in the neck. Following necessary care at the site of injury, the skin is closed loosely and a drain is placed superficially.

ADJACENT WOUNDS

The bony barrier between the neck and chest is the first rib on each side attached to the sternum. The bony barrier between the neck and axilla is the clavicle on each side. These barriers between adjacent zones of soft tissue interfere with the freedom of manipulation which is necessary to cope with extensive neck wounds.

The floor of the mouth and mandible are also frequently injured in wounds involving the neck. Thus these zones adjacent to the neck must be studied and, when necessary, exposed in order to complete the care of injuries to important structures—blood vessels and food and air passages. The control of blood flow in the carotid, innominate, and subclavian arteries must not be assayed lightly in an emergency room.

Note: The neck is an anatomic segment of the body which lies in the field of the laryngologist, maxillofacial surgeon, neurosurgeon, and chest surgeon. It is also the concern of the anesthetist in maintaining an airway. Consultation between competent personnel is most desirable.

CONCOMITANT INJURY

Failure to examine the rest of the body of the patient who has a severe neck injury may be cause for an avoidable disability or a fatal issue, even when proper care for the neck wound has been done. An unreduced dislocation of a thumb may be insignificant when compared to a life-endangering wound in the neck. However, while the patient may recover from the neck injury, the untreated thumb may result in a disabled hand.

Prepared for Modern Medicine

Injuries to the Thorax

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WHETHER injury to the thorax is open or closed, the problem remains the same—disturbed cardiorespiratory physiology.

To obtain gaseous interchange in the alveoli, we must have [1] rhythmic muscular action, [2] a semirigid expansile cage, and [3] a system of conducting airways. It is vital that the alveolar exchange be of sufficient amplitude and over a large enough space to prevent anoxia. Therefore, the tidal air volume must be effective and the airways unobstructed.

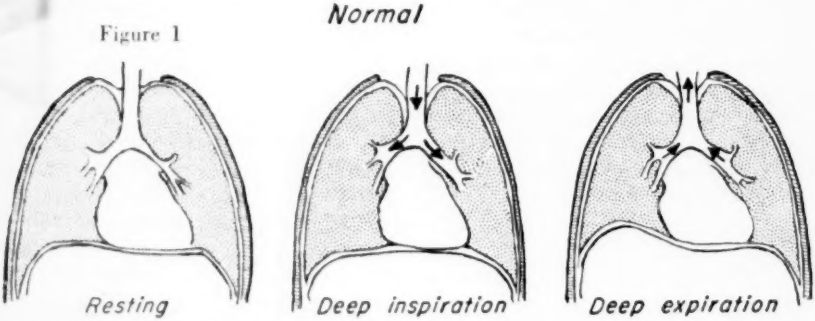
Moreover, intrapleural pressures influence cardiac filling from the great veins. Reflexes from peripheral nerves because of pain will initiate bronchospasm and increase bronchial secretion. The reflexes may also affect cardiac action and peripheral resistance in the vascular bed.

Normal exchange of air in the lungs is demonstrated in Figure 1. Lungs are unobstructed; intrapleural pressures are equal at all times. This results in equal bilateral filling and emptying of the lungs.

In Figure 2, one pleural cavity is open. The intrapleural pressure is atmospheric and the lung collapsed. Because of pressure differentials between the two sides, the mediastinum shifts and reduces the space on the good side. Respiratory movements not only reduce expansion of the good lung, but an exchange of unoxygenated air also occurs between the good and collapsed lung. Thus the tidal volume is decreased. Mediastinal shift and reduced intrapleural pressure interfere with cardiac filling.

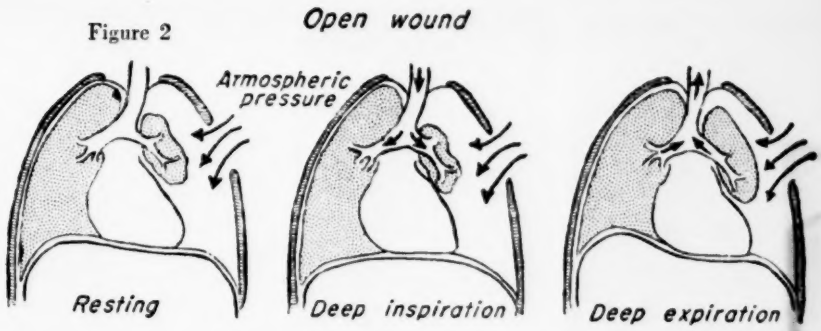
Every patient with chest trauma is apt to suffer pain; the pain must be allayed in such a way that breathing and coughing do not meet with interference. This is best

Figure 1



*Assistant Clinical Professor of Surgery, Wayne University, Detroit.

Figure 2



accomplished by intercostal nerve block. The technic is simple and one block often brings permanent comfort.

Strapping of the chest is usually ineffective in stopping the pain and is certainly unphysiologic. Chest expansion is reduced and the expulsion of secretions impeded. Morphine will only make things worse. The total result is [1] decreased cough reflex, [2] limited excursions, and [3] ineffective expulsion of secretions. These are the forerunners of "wet lung."

WET LUNG

The roentgen signs of wet lung are often minimal, but may be pronounced, as shown in Figure 3. In the case illustrated, the patient was stabbed in the left chest twenty-four hours before the film was made. There was no obvious pulmonary laceration or hemorrhage, but the roentgen picture is that of bronchopneumonia, the result of restricted respirations and ineffective cough caused by pain alone.

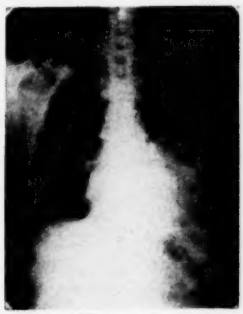


Figure 3

Wet lung can be expected to some degree in nearly all cases of chest trauma, and frequently the treatment of this complication alone will decide the outcome. The condition is characterized by a wet, ineffective cough, and often the rattles and wheezes may be heard across the room. Coarse râles are always found on physical examination. The cough is extremely ineffective and secretions continue to back up, resulting eventually in full-blown atelectasis with cyanosis, dyspnea, and so forth.

The problem is how to make the cough effective. Impressing the patient with the importance of coughing is necessary. Above all, intercostal blocks must be used to allay all pain. The response is often dramatic. Frequently patients who have shallow, gasping respirations with rattles, wheezes, wet cough, and apprehension will respond within half an

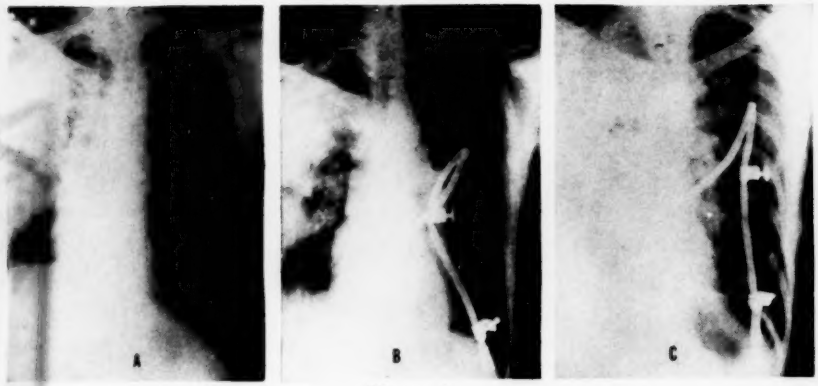


Figure 4

hour, resume normal dry respirations, and fall asleep.

A patient with pneumothorax following multiple rib fractures on the left is shown in Figure 4A. Mediastinal shift and wet lung on the right may be noted. The patient is suffering more from atelectasis of the good lung than from pneumothorax. In Figure 4B, although the pneumothorax is partially expanded, the mediastinal shift persists and the atelectasis increases. Figure 4C shows progress to massive atelectasis on the right.

Proper treatment in this case would be [1] nerve blocks and encouragement to cough; [2] if this proved ineffective, bronchial aspiration should be done with a catheter; and [3] if this was ineffective, bronchoscopy should be used. Nasal oxygen, 7 to 8 liters per minute, should be given.

Why do secretions accumulate in these cases? Mainly because of [1] ineffective expulsion as a result of pain and [2] excessive secretions. Experimentally, bronchospasm and increased bronchosecretions have been produced by the stimulus of the pleural pain. Pulmonary damage with the transudates, exudates, and blood adds to the secretions. Upper respiratory infections should not be overlooked as a cause for increased secretions.

In exhaustion or semicomatose states, it may be necessary to resort to tracheobronchial aspiration. The catheter may even be indwelling. Suction should be employed for a few seconds at a time. In addition to removing the secretions, the presence of a catheter stimulates coughing. When none of these measures is effective, the bronchoscope must be used.

PNEUMOTHORAX

The source of *closed pneumothorax* is usually laceration of a lung; the ordinary outcome is spontaneous closure of the bronchopleural fistula, unless large.

Open pneumothorax, or sucking wound, presents an emergency insofar as it is necessary to tampon-

ade the wound with any material handy and relieve pneumothorax. Definitive treatment of the wound is undertaken after the patient's general condition improves.

Tension pneumothorax results from ball-valve action in lung or chest wall. The physiologic result is [1] diminished aeration space, [2] mediastinal flutter, and [3] obstruction of venous return to heart. Treatment is directed toward relief of the pneumothorax. Aspiration will suffice in emergencies, but catheter drainage under water is required eventually. The tube should project just under the water. The deeper the tube is in the water, the more expulsive the force required to expel air and blood.

Figure 5

Figure 6

Treatment for bilateral pneumothorax is illustrated in Figure 5. The patient was struck on the chest in an auto accident. No rib fractures were seen, but roentgenograms do not always disclose these. Bilateral pneumothorax with a thoracotomy tube in each pleural cavity was life saving. The aerating lung surface was reduced too much to support life for long.

A frequent accompaniment of rib fracture is massive subcutaneous emphysema, and sometimes mediastinal emphysema. We have not yet found incision necessary for emphysema and believe definitive treatment is not needed. If pneumothorax is present, a thoracotomy tube diverts the pleural air from the tissues so that the emphysema subsides. Early thoracotomy drainage does not hinder closure of lung laceration.

Figure 6 illustrates another case of pneumothorax from a fracture of the right fourth rib posteriorly. There is also a collection of blood in the pleural cavity. A thoracotomy tube was successful in removing both blood and air.

Open pneumothorax is treated with a thoracotomy tube after tamponade of the sucking wound. In the case shown in Figure 7, note that on inspiration [1] air passes from the collapsed lung to the good lung, [2] air enters pleural space, and [3] the mediastinum shifts to the good side. Thus aerating space is reduced and a certain amount of

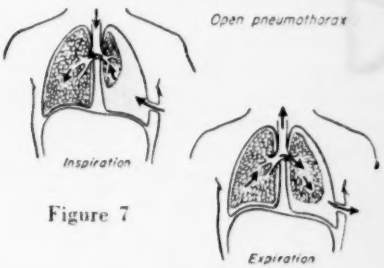


Figure 7

spent air is exchanged from one lung to the other.

These patients do not respond well to shock therapy. Dyspnea and cyanosis may be pronounced. Closure of the wound itself will give the patient some relief, but tension pneumothorax may develop after closure. If this is unrecognized, a fatality may result.

Shock occurs with many penetrating wounds of the chest. Experimental evidence indicates that so-called pleural shock is of a reflex nature and results from diminished peripheral resistance. Cardiac output and atrial pressure are normal. Response to shock therapy, however, is prompt. If this is not the case, tension pneumothorax, severe intercostal and internal mammary bleeding, flail chest, obstructed airways, massive collapse, or cardiac tamponade should be searched for and treated.

The deviation of the mediastinum in tension pneumothorax is illustrated in Figure 8. The arrow points to a hole in the lung. This hole opens on inspiration and air enters the pleural space. Pleural space pressure then closes the laceration on expiration and air remains trapped. A continuation of this cycle will be fatal. It should be suspected in all chest cases, particularly when dyspnea and cyanosis are increasing. Response to shock therapy is poor in these cases.

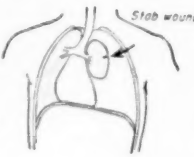


Figure 8

Mediastinal shift, pneumothorax on the left, and some gastric dilatation following gunshot wound of the left chest are shown in Figure 9. Gastric dilatation is another factor which will limit respiratory excursion. This occurs frequently in chest trauma and may be extreme.

Abdominal tenderness, rigidity, rapid shallow respirations, and obvious distention may occur. A Levine tube placed in the stomach will produce rapid and marked improvement. In Figure 10 the stomach is seen occupying at least one-third of the abdomen.

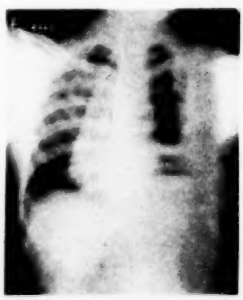


Figure 9

Figure 10

Pulmonary lacerations seldom form abscesses. The usual course is one of gradual resolution. A gunshot wound of the left chest just to the left of the nipple, with intrapulmonary density above the left diaphragm, is shown in Figure 11A. Such blood as accumulated was aspirated. Five days later (Fig. 11B), the pulmonary shadow is more sharply outlined and concentrated. Most of the pulmonary shadow is due to contusion, blood, and surrounding exudate. Seventeen days after injury (Fig. 11C), the pulmonary shadow is almost metallic in sharpness and density.

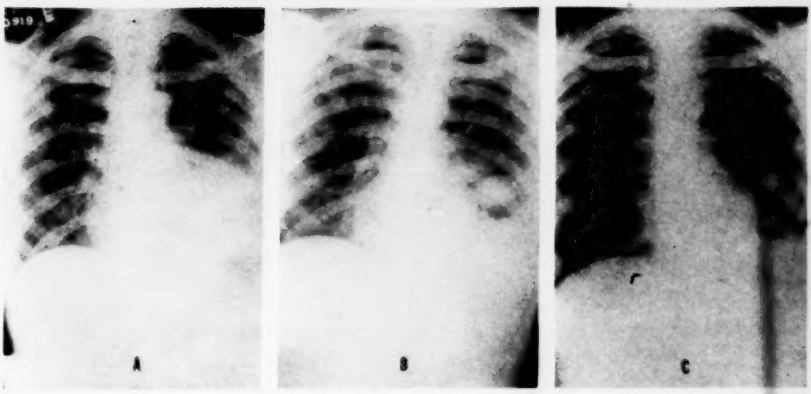


Figure 11

The treatment of hemothorax has excited much debate. The statement is frequently made that blood in the pleural cavity does not clot. Experiments of Kato tended to show that the pleura produced a substance which kept blood liquid. This has been disproved. Since 1829, numerous experiments have shown that blood in the pleural cavities of animals always clots, and clots quickly. The same is true in human beings. In the living animal, the action of the heart and lungs defibrinates the blood, depositing the fibrin on the pleural surfaces and squeezing the red cells into the serum.

The harmful effects of leaving blood in the chest because of the danger of fibrothorax have been very repeatedly demonstrated. Blood should always be removed before a thick fibrin layer forms on the visceral pleura. The needle is usually placed in the most dependent interspace and as much blood as possible is removed, or until the patient experiences discomfort. No air is injected. Air will not prevent rebleeding and rebleeding seldom occurs. Air will irritate the pleura and cause exudation.

Although aspiration will handle many cases of hemothorax, loculation occurs and organization proceeds in others. The factors which produce this are unknown. The fibrin becomes layered on the pleura, more so on parietal pleura, and forms a peel. In due time, this becomes organized into fibrous tissue and encases the lungs, preventing expansion permanently. If the peel is sufficiently extensive, the entire lung may be practically eliminated as a source of respiration.

To rehabilitate this lung, decortication is necessary, best done three to six weeks after injury. Prior to then, the peel is too soft and a cleavage plane is difficult to obtain. If one waits too long, fibrous tissue prevents easy removal. Only the visceral peel need be removed.

A case of stab of the left chest with pneumothorax and a small collection of fluid on day of ad-

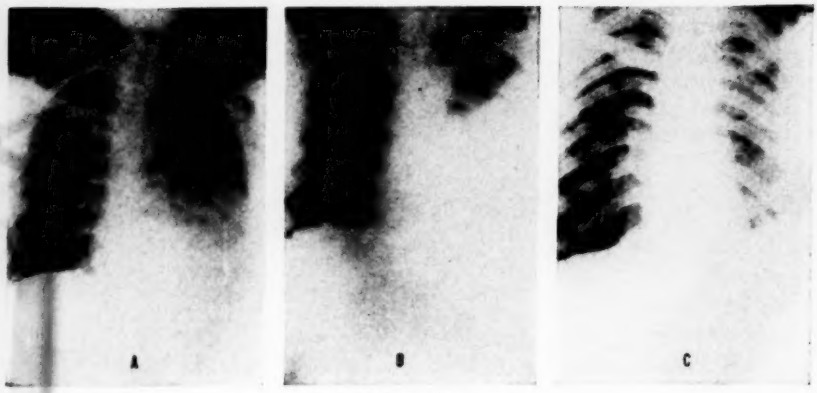


Figure 12

mission is shown in Figure 12A.

Four days later (Fig. 12B) the fluid has increased. The pneumothorax has almost entirely disappeared. The increase in fluid is often interpreted as continued bleeding. This is seldom true. The increase results from pleural exudation. These fluids show hemoglobin values much lower than in blood.

One month later, after decortication (Fig. 12C), a good lung field is visible, with good expansion on the affected side. By the time surgery is performed, the patients begin to demonstrate [1] restricted excursions, [2] scoliosis, and [3] narrowing of the rib interspaces on the affected side. The last two conditions are demonstrated in Figure 12C. After operation, these evidences of fibrothorax gradually disappear.

FLAIL CHEST

One of the more severe chest injuries is the crushed or flail chest. Treatment is often unsuccessful, since the condition is frequently associated with other severe trauma.

The flail chest results in an interpulmonary exchange of air similar to that with open pneumothorax. Thus an interchange of unaerated air occurs. The aerating space is reduced and mediastinal flutter exists. Even more damaging in many cases are the grunting, shallow respirations resulting from pain. A flail chest will respond well to nerve block and the paradoxic motions often decrease greatly and become of no importance. Wet lung is an ever constant threat.

Enforced coughing and nerve blocks are vital, and nasal oxygen is usually needed. Catheter suction or bronchoscopy may be necessary. In these cases a binder may be permissible to stabilize the chest or sandbags be effective if placed against the flail segment.

In more severe cases of crushed sternum, we have used a cervical tenaculum with traction to pull on

the sternum (Fig. 13). For ribs, we have used towel clips, wire, and the like.

Blast effect is seldom encountered in civilian life. Small intrapulmonary hemorrhage exists and pulmonary edema often intervenes. Positive pressure oxygen is an aid in drying up the edema.

Occasionally one sees so-called traumatic asphyxia in which the patient's face, neck, and upper limbs are cyanosed and contain innumerable petechiae. The subclavian and jugular veins are valveless and a sudden pressure on the thorax pushes blood with great force back into these areas, causing the characteristic appearance.

HEART WOUNDS

An interesting group are the wounds of the heart. Cardiac contusion sufficient to give electrocardiographic findings is not uncommon. The ordinary signs of cardiac wounding evolve about tamponade of the heart. These signs are venous engorgement from the elevated venous pressure, pulsus paradoxus, low arterial pressure, and quiet heart shown on fluoroscopic study.

This combination depends upon the filling of the pericardium with blood, thus preventing cardiac filling. These symptoms are by no means always present and wounding of the heart may be discovered several days later.

In one instance, we removed 2,000 cc. of blood a month after injury by pericardotomy. Another patient was shot through the sternum with the bullet lodging in T-9. The patient died of mediastinitis

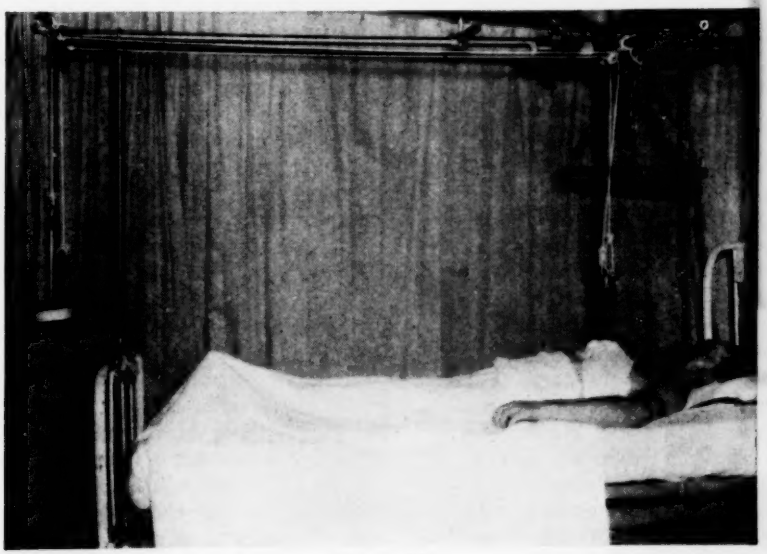


Figure 13

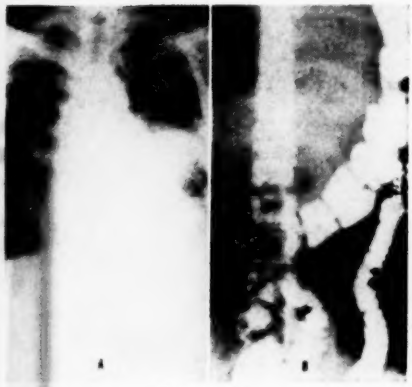


Figure 14

from a perforation of the esophagus by the bullet. At autopsy, a through-and-through wound of the right auricle with good scar tissue was found. This patient might have been saved if the esophageal perforation had been recognized and repaired. There was obviously no cardiac tamponade and the heart had healed quite effectively.

DIAPHRAGM RUPTURE

Rupture of the diaphragm is occasionally seen. Injury is usually very severe. This condition in a patient with multiple fractured ribs on the left is illustrated in Figure 14. Gas of large bowel pattern is seen in the left chest (Figure 14A). Barium enema confirms this (Fig. 14B).

The diagnosis of a diaphragmatic hernia, which is almost always on the left, is not difficult to make, but the condition is uncommon and sometimes not considered in differential diagnosis.

Figure 15

ABDOMINAL WOUNDS

Mortality from thoracoabdominal wounds is considerably higher than from wounds of either thorax or abdomen alone. When in doubt, exploration is advisable and is generally best accomplished through the chest. All abdominal organs, except pelvic viscera, cecum, terminal ileum, and lower colon, can be conveniently examined through the left diaphragm. Splenectomy is much easier by this route.

In general, complications more often arise from the abdominal injury than from the thoracic injury. The pleural cavity may resist gross contamination from the gastrointestinal tract. It is generally considered proper in wounds on the right when the liver is involved to repair the diaphragm and provide drainage from the liver through the abdomen. Otherwise, bile may break down the suture line in the diaphragm and cause bile pleuritis, which usually results in empyema. We ordinarily provide drainage to the chest with a water-seal bottle after surgery.

A wound located in the diaphragm may be an unrecognized potential sucking wound, that causes an open pneumothorax when the abdomen is opened.

One of our patients was injured in the left lower chest four months

before admission. She had clinical signs and symptoms of a left subphrenic abscess. The fluid in the left chest was slightly blood-tinged. A gastrointestinal series was important here. The stomach (Fig. 15) was displaced medially because of accumulated blood clots in the left upper quadrant from delayed splenic rupture. This case also illustrates injury to abdominal organs with nonpenetrating chest injury.

Outline of Treatment

Thoracic injuries, in general, require [1] oxygen to control dyspnea and anoxia, [2] chemotherapy in most instances, [3] forced coughing in all cases, [4] intercostal blocks to allay pain, and [5] early ambulation if possible.

FRACTURED RIBS Use intercostal nerve block so that no sedation or strapping is required. Injury to the cage is usually unimportant, but of vital significance are damage to intrathoracic organs, complications of hemothorax, pneumothorax, and flail chest.

HEMOTHORAX Rely on roentgenograms for diagnosis. Serial roentgenograms must be obtained; physical diagnosis is inadequate. Do early aspiration for any appreciable quantity of blood to prevent organizing hemothorax. Use intercostal block for pain and restricted respirations. Decorticate organized hemothoraxes.

SUCKING WOUNDS Immediately transform to a closed pneumothorax. If pressure pneumothorax does not develop, the chest wall is debrided and closed. Aspirate air and blood by multiple thoracenteses or water-seal drainage.

CLOSED PNEUMOTHORAX Aspirate air by multiple thoracenteses or water-seal drainage.

TENSION PNEUMOTHORAX Aspirate air with water-seal drainage.

FLAIL CHEST Support chest wall by towel clips around ribs or cervical tenaculum grasping sternum.

HEART WOUND Watch for development of triad. Use immediate fluoroscopy and serial roentgenograms. Operate as soon as diagnosed.

ESOPHAGUS WOUND Insert Levine tube for blood or esophagoscopy. Do immediate closure.

THORACOABDOMINAL WOUNDS Keep anatomy of lower thoracic cage in mind to recognize likely abdominal organ injury. Immediate surgery is required.

Prepared for Modern Medicine

Abdominal Injuries

GEORGE D. LITTLE, M.D., AND JOHN H. DIXON, M.D.
Montreal General Hospital

THE purpose of this communication is to give the practitioner a guide for the management of abdominal injuries. In preparation, the authors have reviewed the current literature on the subject for the past ten years. In addition, records from cases handled at the Montreal General Hospital for the past twenty years have been examined.

Various types of abdominal injuries occur. They may be divided into penetrating, nonpenetrating, and blast wounds.

TYPES OF INJURY

Penetrating wounds include any injury in which foreign material has pierced the skin or mucous membrane. Examples are gunshot and knife wounds and perforation of the gut, bladder, or uterus by instrumentation.

Nonpenetrating wounds may be caused by compression, traction, or disruption forces.

Compression forces may be local, general, sudden, or gradual. Usually the force compresses the organ against the spinal column causing injury to either solid or hollow viscera, or both, and may drive fragments of ribs or pelvic bones into adjacent structures of the body.

Traction injuries are ordinarily at the junction of fixed and mobile portions of the bowel. Tearing occurs when the mobile portion is suddenly arrested by the fixed portion. The commoner fixed portions of the gastrointestinal tract are the mesenteries, duodenojejunal junction, and ileocecal junction.

A disruption force is one that is exerted against the inner walls of hollow viscera causing the wall to give way. Areas weakened by disease or previous trauma are the most prone to burst. Enemas given with too much hydrostatic pressure or directly from water taps are common sources of injury. Compression forces applied over hollow, distended viscera, such as the stomach shortly after a heavy meal, the expanded bladder, or the pregnant uterus, may cause rupture.

Blast injuries include damage from high compression gases and may also be the result of immersion blasts, as in World War II when depth charge detonations injured survivors floating in the water; such injuries are uncommon in civilian practice. High explosives on the surface may cause blast injuries. Injuries from compressed air blasts are rather rare, but we have seen 3 cases in which compressed air blast was inadvertently aimed at the victim while he was bending over, with resulting multiple perforations of the rectum and the colon.

TYPES OF CASES

Clinically, any abdominal trauma falls into one of three groups:

1] Severe multiple injuries which are rapidly fatal and for which no treatment avails. Automobile accidents are the most frequent causes of these injuries.

2] Cases that obviously require immediate operation. In this group are the penetrating injuries of which gunshot wounds are the commonest.

3] Cases in which the diagnosis is doubtful and indications for or against operation are not clear. Most nonpenetrating injuries are in this group, and are commonly caused by falls or blows.

FIRST MEASURES

First aid—As a rule, first-aid measures are handled by men trained to treat primary shock by warmth and application of bulky dressings to wounds without disturbance of embedded foreign objects, and to transport the patient to the hospital as quickly as possible.

Preliminary examinations—Temperature, pulse, and blood pressure are recorded at the first examination. The presence or absence of shock is noted.

A rapid but thorough history should be taken and physical examination performed. Associated injuries can thereby be assessed. Concomitant thoracic and skull injuries in particular are as important as the abdominal injuries. Fractured extremities can usually be treated by temporary splinting until the abdominal injuries are dealt with.

Inspection of the abdomen will reveal any penetrating wounds. Anatomic relationship to abdominal viscera will immediately help to localize the extent of injury. In the case of gunshot wounds, a careful search for the entrance and exit wounds should be made. The entrance is smaller than the exit wound and is associated with an area of abrasion and contusion. The wound of exit is usually keyhole in shape. When the exit wound cannot be seen, careful palpation may reveal the bullet in the subcutaneous tissue.

Muscle splinting or guarding suggests intraperitoneal damage. Palpation of the umbilicus or of the pelvic peritoneum by rectum will reveal cases with even minimal peritoneal irritation. Localized tenderness with guarding in the right or left upper quadrant, particularly with associated fractured ribs, is indicative of liver or spleen injury; a palpable mass with tenderness in the loin is suggestive of renal damage.

Localized suprapubic tenderness, particularly in the presence of a fractured pelvis, may signify bladder injury. In civilian practice, 95% of the ruptured bladders are associated with fractured pelves.

Absence of bowel sounds during auscultation of the abdomen is suggestive of gastrointestinal tract injury.

Blood that is vomited or aspirated through a gastric tube is indicative of perforation of the upper gastrointestinal tract. Blood detected on rectal examination makes injury to the rectum or colon suspect.

Intubation and catheterization—Upon completion of the physical examination, a Levine tube is passed for upper gastrointestinal tract decompression. This is a useful diagnostic as well as therapeutic procedure. The bladder is catheterized, and an immediate urinalysis may reveal genitourinary damage.

Roentgenograms—If the condition of the patient warrants, roentgen studies are made next, including scout films of the abdomen and pelvis in both prone and upright positions and a chest film. If the injury results from penetrating foreign bodies, lateral roentgenograms are also made to aid in localization of the missile.

EARLY TREATMENT

Shock is of primary importance regardless of the diagnosis. The patient should be sedated with some analgesic. Routine administration of narcotics in shock is condemned. Not only are important abdominal signs masked but respiratory depression ensues which further aggravates the shock. Narcotics should be used only for extreme pain or restlessness.

The Trendelenburg position is to be used in all cases of shock. The patient must be kept comfortable by blankets to prevent loss of body heat. Abdominal bakers are of no value and may do harm by increasing the peripheral circulation, causing anoxia to vital organs.

Blood and plasma are administered as necessary. Arterial transfusions by cut-downs or arterial puncture at the radial or femoral artery are of great value when intravenous therapy fails. Hematocrit and hemoglobin determinations should be made at hourly intervals during the acute phase of shock so that blood or plasma replacements can be supplied accordingly. As a rough guide, 1 liter of blood should increase the red blood cell count by 1,000,000 cells per cubic millimeter.

The danger of prolonged hypotension with irreversible damage to the liver, brain, heart, and kidneys should always be kept in mind. Systolic blood pressure below 60 mm. of mercury for four hours is almost certain to produce these changes. Nasal oxygen at the rate of 3 to 6 liters per minute is recommended by many. Continuous intravenous glucose and water will greatly aid in maintenance of circulating blood volume if sufficient blood is not available. Dextran, a polysaccharide sugar administered in a 6% solution dissolved in normal saline, is a good adjunct and is better than glucose and saline.

Antitetanus serum and *penicillin therapy* should be used for all cases of open wounds. Administration of other antibiotics such as terramycin and Chloromycetin to sterilize the gut is also useful.

In early treatment *one surgeon should follow the course* of the patient, so that changes in the condition may be detected early.

WHEN TO OPERATE

If hemorrhage is suspected and the patient fails to respond quickly to active shock therapy, operation for control of hemorrhage should

be performed without delay, unless the patient is moribund. If improvement follows shock therapy, operation for hemorrhage or possible recurrent hemorrhage is not immediately mandatory and will depend on the viscera involved.

Debridement of external wounds should be done as soon as possible. Further exploration at the time will depend on the nature of the injury.

• *Ruptured hollow viscus, including stomach, duodenum, or large or small bowel*—The most important findings that point to diagnosis of injury of the gastrointestinal tract are:

- History and site of trauma
- Localized pain, tenderness, and rigidity which persist and tend to spread
- Absence of peristaltic sound
- Quiescence of patient
- Loss of abdominal respiratory movements
- Rising pulse rate
- Persistent vomiting
- The extremely important roentgen finding of free air or gas in the peritoneal cavity
- Rapidly increasing leukocytosis
- Abnormalities of hematocrit and hemoglobin

However, absence of one or more of these does not eliminate the existence of serious injury.

Free air demonstrated by roentgenograms probably indicates rupture of the stomach, duodenum, upper jejunum, or colon. The lower jejunum and ileum are less likely to reveal free gas. Sometimes the rupture of an abdominal viscus will not be demonstrated until a localized abscess, which could not be detected clinically, has broken and diffuse peritonitis has resulted. Once the diagnosis is made, operation should not be delayed, but in this instance the urgency is not as great as in that of suspected abdominal bleeding and time can be taken for adequate shock therapy.

The choice of anesthetic for operation is influenced by the probability of shock; any method likely to produce hypotension is avoided. We prefer some form of general anesthesia with or without relaxing agents.

The abdomen may be explored either through a rectus-splitting or a midline incision and the bowel should be completely and systematically examined. Perforations of the stomach and small bowel may be closed by inverting sutures of catgut, silk, or cotton. Multiple lacerations in a loop of bowel or loss of its blood supply occasionally require resection and anastomosis.

Perforation of the colon may be treated by exteriorization of the bowel or repair of the opening followed by a proximal colostomy. After the operative procedure, the abdomen is flushed out with saline; drains are used in most cases.

• *Ruptured spleen*—The architecture of the spleen is such that even slight trauma may tear the soft parenchyma. Once a tear has been made, bleeding tends to continue for a long time.

Injuries of the spleen may be divided into three groups:

1] Rupture followed by rapidly fatal massive hemorrhage

2] Rupture with initial hemorrhage and collapse, then recovery. After a latent period, usually hours, hemorrhage recurs and will cause death unless splenectomy is done.

3] Subcapsular hematoma. The splenic pulp is torn under an intact capsule. The bleeding continues, the pressure under the capsule increases, and for two to ten or more days the patient seems to have no serious intraabdominal injury. Suddenly the hematoma breaks through the capsule and profuse hemorrhage occurs. An accurate diagnosis is often impossible.

The nature and site of the injury combined with pain, tenderness, and rigidity in the left upper quadrant will direct attention to the splenic area. Occasionally pain is felt in the left shoulder and, at times, a serrated stomach gas shadow caused by the enlarging spleen appears on the scout film of the abdomen. Persistence of the signs and symptoms with associated manifestations of blood loss indicates exploratory laparotomy. In all cases of damage to the spleen, splenectomy is the safest procedure.

• *Ruptured liver*—Injuries of the liver may be classified as:

1] Rupture of the liver tissue with simple laceration of Glisson's capsule representing minimal trauma

2] Separation of the capsule by subcapsular hemorrhage and damage to underlying structures

3] A central rupture with hemorrhage into the parenchyma with later abscess formation.

Diagnosis is made by the history, site of trauma, signs of intraperitoneal hemorrhage and localized tenderness, and rigidity, elevation, and immobilization of the right leaf of the diaphragm.

Laparotomy is performed if the signs of intraperitoneal hemorrhage persist. Tears of the liver are repaired by multiple mattress sutures or by packing with gauze and gelfoam. Sometimes a free muscle graft from the rectus muscle may be packed into the defect.

• *Ruptured kidney*—(See page 132).

• *Injuries to bladder*—(See page 132).

• *Retroperitoneal bleeding*—Hemorrhage can occur from any of the retroperitoneal structures. Pancreatic injuries are usually associated with other serious visceral damage and may be detected only at autopsy or, if the patient survives, by discovery of pancreatic cyst. Rupture of the great vessels is rapidly fatal.

If not immediately fatal, continued retroperitoneal hemorrhage is often very difficult to diagnose. In some cases telltale extravasation of blood appears in the subcutaneous tissues of the loin and back.

Abdominal signs vary with the extent of injury and differentiation between intra- and retroperitoneal hemorrhage is often impossible. Paralytic ileus is usually present and shock may be severe. Treatment should be nonoperative. If laparotomy is performed and a retroperitoneal hematoma is discovered, no further exploration should be attempted and the abdomen should be closed without disturbing the hematoma.

BLAST INJURIES

Immersion blast injuries of the abdomen may occur during an underwater explosion with the victim turned toward the blast. If he survives, the victim feels as if he had

received a terrific kick in the abdomen. Recovery from primary shock usually occurs within a few minutes.

Upon being rescued, the patient soon has severe abdominal pain with vomiting of bloody material and watery, bloody diarrhea. Secondary shock, which may be severe, develops; the course is usually febrile with bouts of distention, abdominal rigidity, and severe crampy abdominal pain. The extent of injury is difficult to assess; the decision to operate should be made within twelve hours. Laparotomy is performed in all doubtful cases.

Besides treating shock, symptomatic therapy is all that can be offered in the nonoperative cases. The mortality rate continues to be high.

Surface blast injuries due to high explosives are similar to penetrating wounds and require no special discussion.

If a compressed air blast has been aimed at the buttocks, rectal perforation is highly probable and the patient should be investigated immediately. Proctoscopic examination and scout films and lateral roentgenograms of the abdomen in search of free gas should be performed as soon as possible. A strong suggestion of rectal perforation is sufficient indication for immediate laparotomy.

Doctor to Doctor

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"When I asked if he wanted a one- or two-bed room he asked, 'What would I do with two?'"

Prepared for Modern Medicine

Management of Genitourinary Trauma

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THE literature concerning the treatment of genitourinary injuries is confused in both theory and practice. Since preference should be given to simple and safe methods of early management, it is this aspect of the problem that will be discussed.

Although trauma to the genitourinary tract often occurs coincidentally with injuries of other structures, little attention has been given to consideration of their simultaneous management. Particular emphasis has been placed on the visceral or bony lesions that may occur in the severely injured patient. These injuries may be more obvious than the genitourinary lesions but are not always more significant. Every physician with extensive experience in traumatic surgery realizes that genitourinary injuries frequently present special difficulties in recognition and evaluation.

DIAGNOSTIC MEASURES

The existence of urologic trauma is readily discerned in most instances. History of an accident, with or without external evidence of injury, pain and tenderness in the kidney or bladder areas, and the finding of hematuria more than suffice to warrant a diagnosis of trauma to the genitourinary tract.

However, in some cases, even after a careful critical examination, one is not able to make an exact clinical appraisal. In these instances, the history of trauma may be trivial or absent and external evidence of trauma be lacking. In addition, the symptoms are sometimes confusing or misleading or vital objective findings may be missing. Equally disconcerting are those cases in which, for one reason or another, no blood is found in the urine.

The problem, however, is not so much that of detecting the presence of urologic trauma as of knowing the exact extent of the injury. Urologic injuries will be missed less and less if physicians adopt the attitude that after any injury that may conceivably involve the genitourinary system, an immediate and complete urologic investigation should be performed. My experience with urologic trauma has stressed the fact that no relationship exists between the intensity of the trauma, the clinical signs, the symptomatology, and the gravity of the urinary tract lesion. An accurate portrayal of the extent of injury can in most instances

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be established only by a thorough urologic roentgen study of the patient, done as soon as possible after the patient's admission to the hospital.

Roentgen examination aims to determine whether extravasation, which is indicative of rupture, does or does not exist. This approach represents the only scientific and positive method toward the establishment of an anatomicopathologic diagnosis. The importance of roentgen examination in the evaluation of conservative versus operative intervention cannot be overemphasized.

WHEN TO OPERATE

Rupture of the bladder or urethra demands immediate surgical interference to avoid the high mortality associated with these lesions. If a rupture of the lower urinary tract is operated upon within twelve hours, the average mortality is 11%; if operated upon after twenty-four hours, the mortality rises to 44%.

It is generally agreed that immediate operative interference is warranted for patients who have sustained renal injury and have profuse, continued hemorrhage. Opinions differ concerning renal injuries which do not fall into the above classification. One group feels that these patients should be treated conservatively without operation and that any complications which may arise should be taken care of later. Another group, with which I am in complete accord, states that if extravasation is demonstrated, surgical interference should be instituted at the propitious time, usually within three or four days after the injury. When roentgen study demonstrates no extravasation from the kidney, bladder, or urethra, the patient can be treated conservatively with a great deal of assurance that no serious lesion exists.

The pyelographic evidence of extravasation forms the basis for the surgery on the kidney before deterioration makes such interference necessary. Operative interference in these cases does not imply a radical approach, because the primary principle is to save the kidney rather than to do a nephrectomy. Conservative surgery in these cases enables one to make the necessary repairs and to conserve the kidney by drainage and arrest of bleeding. Careful observation has shown that this policy leads to better results and the salvaging of many kidneys that might otherwise require nephrectomy later.

At times, extirpation of a kidney may be deemed necessary because of grave hemorrhage or because a urologic roentgen investigation has disclosed that the kidney is shattered beyond hope of repair. For obvious reasons, before nephrectomy, a good contralateral kidney should be demonstrated.

STANDARD ROUTINE

Recognizing the fact that one cannot be dogmatic about traumatic surgery, an orderly, standardized routine, whenever feasible, is far superior to a haphazard approach or none at all. We have accordingly set up the procedure outlined in the table for the investigation of a patient

with possible genitourinary trauma at Beekman-Downtown Hospital.

- Completely undress patient and rapidly examine.
- Type and crossmatch for at least 1,500 cc. of blood.
- Treat shock.
- Give complete physical examination.
- Make simple abdominal roentgenogram.
- Catheterize.
- Clamp catheter.
- Do excretory urography; obtain late films of the bladder.
- If necessary, unclamp catheter and make retrograde cystogram.
- If necessary, pull catheter down into the urethra; if unable to insert catheter, make urethrocystogram.
- Perform a cystoscopic examination and make retrograde pyelogram when indicated and feasible.

Immediately after admission to the hospital the patient should be transported to a bed. Here he is undressed completely and a rapid physical survey is performed. Careful charting of blood pressure and pulse readings every fifteen minutes should be done.

Since many of the patients are in shock, typing and crossmatching for at least 1,500 cc. of blood should be done without delay. If blood is not available, adequate plasma or plasma extenders should be administered until whole blood is obtained.

A thorough physical examination is performed to determine the existence of any complicating associated injuries. However, injuries of the brain, abdominal viscera, and chest may not be manifest for a time. An injury to the kidney may be associated with damage to other regions—fracture of the last two ribs or of the transverse processes of L 1, 2, 3, and 4 on the affected side and contusion or rupture of the liver or spleen. Coincidental damage to the pancreas, gastrointestinal tract, and chest is not uncommon. Fracture of the skull, concussion of the brain, and fracture of the pelvis have also been found as complicating injuries. The prevalence and wide distribution of these associated lesions, and the fact that they may be more serious than the urinary tract lesion, illustrate their importance in the management of genitourinary trauma.

Ideally, the patient should then be transported to the radiology department for roentgen study. However, if the general condition or severe associated lesions contraindicate movement, roentgen examination may be safely and quickly performed at the bedside. A technic using the portable roentgen apparatus and a Lysholm grid over a standard cassette in a cassette tunnel positioned under the patient yields diagnostic radiograms. The procedure for bedside urologic roentgen examination is easy to execute, is without harm to the patient, and may frequently be life saving.

A simple abdominal film will give an initial lead concerning the injury and may be made while the patient is receiving treatment for shock. Under ideal circumstances, the simple film may demonstrate a grossly enlarged kidney on the affected side, air under the diaphragm, or associated skeletal frac-

tures. Especially important is the finding of a fracture of the pelvis, since ruptures of the bladder and urethra occur in about 17% of such fractures; if the pelvic architecture is severely disrupted, the incidence of such ruptures rises to 40%.

CATHETERIZATION

An attempt is then made to pass an F16 soft rubber coudé catheter. The procedure should be gentle and not repeated after two trials. Passage of the catheter into the bladder and evacuation of clear urine does not necessarily mean that the bladder and urethra are intact. Occasionally the catheter may by-pass a tear in the urethra or may go through the rent in the bladder, withdrawing clear urine in both instances.

Similarly, the presence of grossly bloody urine is not indicative of rupture of the lower tract, as this may occur in severe contusion without rupture. Grossly bloody urine may result from a ruptured kidney or a condition entirely unrelated to the trauma. Finally, failure to pass a catheter to the bladder may be due to a stricture of the urethra or to an obstructing prostate and not to a ruptured urethra.

The time-honored method of instilling a measured amount of fluid and noting whether all is returned as a test of lower tract rupture is mentioned only to be condemned. This procedure belongs to the period of 100% mortality.

The catheter is then clamped and intravenous pyelography performed. In addition to the early films of the kidney areas, late exposures up to sixty minutes are made in the attempt to obtain a diagnostic cystogram. If necessary, the catheter is then unclamped and retrograde cystography performed by the injection of 350 cc. of a 6% solution of the contrast material.

RADIOGRAPHY

The decision whether initially to do an intravenous urogram or a retrograde cystogram has in the past been largely based on the presenting signs and symptoms. Properly interpreted, the cystogram is an almost infallible method of diagnosing a rupture of the lower urinary tract. Possible sources of error include incomplete filling of the bladder because of poor excretion or failure to obtain late films in the excretory pyelographic series, failure to distend the bladder to at least 350 cc. in the presence of small perforations, failure to obtain emptying films with the retrograde method, and, finally, a tamponading of the rent by blood clot or other substance preventing extravasation of the contrast substance.

Although the cystogram obtained by retrograde study is much more satisfactory and definite than that seen with the excretory pyelogram, our routine has been always to do an intravenous urogram first and then follow with a retrograde cystogram, if necessary. By this procedure, the integrity of the upper urinary tracts may be determined as, occasionally, one may be able to demonstrate extravasation from

the bladder or posterior urethra without resorting to retrograde injection of the contrasting material.

Opinions differ about the value of cystoscopy with or without retrograde pyelography in the diagnosis of genitourinary injuries.

Though observation cystoscopy would seem to be an ideal method of determining a rupture of the bladder, merit of the procedure in actual practice seems to be negligible. Bleeding and an inability to distend the bladder sometimes make visualization extremely difficult. In addition, many patients are shocked and have fractured pelves, either of which conditions contraindicates the lithotomy position necessary for cystoscopy. Finally, in the presence of a ruptured urethra, the passage of the cystoscope may be almost impossible and may aggravate the traumatic lesion.

On the other hand, the procedure of cystoscopy and retrograde pyelography has a limited, though definite value in the evaluation of upper urinary tract lesions. The greatest usefulness of excretory urography is in demonstrating the presence and condition of the uninjured kidney. Usefulness is sharply limited to the diagnosis of injuries which are minor in extent and in which the secretory power of the kidney is not impaired. While failure to visualize the injured kidney does not necessarily imply a severely traumatized organ, normal visualization does not exclude a severe pathologic lesion.

Experience has taught me that excretory urography is often misleading, as the procedure does not always portray the actual traumatic lesion. Also, cystoscopy and retrograde study should be done routinely in every instance of renal injury if the patient is not desperately ill or does not have severe associated lesions. The pyelograms obtained by retrograde study are more dependable for an early and accurate diagnosis than those obtained by the excretory method. If the gravity method is used for retrograde injection, I have found the procedure to be safe.

SURGICAL MEASURES

Complete urologic study and planned routine are important to demonstrate an extravasation when present. Once proved, operative intervention becomes imperative. The indications for immediate or emergency operation on the upper urinary tract are determined by the clinical picture of grave, unremitting hemorrhage or a severe associated intraperitoneal lesion.

Thus, if abdominal injury seems more severe, the abdomen should be explored first and intraabdominal lesions repaired. Next, palpation of the loins, although difficult to interpret, may be undertaken. Exposure of the kidney transabdominally lays open a readily contaminated area and is therefore hazardous. If at all possible, exploration of the kidney should be deferred until later; if immediate exploration is necessary, a separate loin incision is preferable.

If the renal injury is considered more severe, the loin should be explored first. After the kidney is cared for, the incision is extended,

the peritoneum opened, and any intraabdominal pathology corrected. This seems the safest procedure. If, however, after careful survey, the kidney alone seems to be involved, one should operate immediately only if severe, unremitting hemorrhage is present. Otherwise, in the presence of extravasation, one should wait three or four days before exposing the affected loin.

The best procedure primarily is arrest of bleeding in the kidney by mattress sutures tied over fat or by packing and drainage of the renal area. Nephrectomy should rarely be performed as a primary procedure. On the other hand, if no extravasation is demonstrated, the kidney lesion is considered as one of contusion, and conservative treatment with rest in bed for two weeks is advised.

Rupture of the lower urinary tract requires operative intervention at the earliest possible moment. Conservative treatment with indwelling catheter should be undertaken only in a doubtful case for a short period of observation or in the desperately ill patient when exploration cannot be done. I have always felt that if the patient's condition contraindicates operation, in addition to using an indwelling catheter, one should infiltrate the suprapubic area with novocain, incise down to the bladder, and insert multiple drains.

Otherwise, suprapubic exploration using general anesthesia is advised. At this time, the peritoneum is gently opened just above the bladder reflection. The finding of bloody fluid or urine warrants a wider opening of the peritoneum and abdominal exploration. Following the correction of any intraabdominal pathology or the suture of an intraperitoneal tear of the bladder, the peritoneum is closed without drainage. Suprapubic diversion of the urine by cystotomy is the best procedure. This diverts the urine, arrests spread of the infection, and allows healing.

Lacerations of the bladder should be sutured, but any undue search for such tears is not advised if the patient is critically ill. With adequate drainage above, most lacerations will heal spontaneously. Undue bleeding encountered about the bladder may be controlled with gauze packing brought out alongside the cystotomy tube. Multiple drains in the space of Retzius and in the lateral recesses of the pelvis are mandatory and should be left in place until drainage ceases and temperature returns to normal.

Rupture of the posterior urethra alone or associated with avulsion of the bladder neck necessitates additional management. Some surgeons advise perineal exposure for the express purpose of doing a primary repair of the lacerated urethra or approximation of the avulsed bladder neck. This is most difficult and, in the hands of the average surgeon, leads to poor end results. Many patients are bordering on shock. The exaggerated lithotomy position necessary for an adequate perineal exposure is difficult to obtain with a fractured pelvis and adds to the shock. I have never found a primary perineal exposure of the ruptured urethra necessary.

As Rutherford has shown, once the patient's legs are extended, the torn ends of the urethra usually fall together. In these cases, retrograde catheterization of the urethra by way of the opened bladder and an indwelling Foley catheter acting as a splint will suffice. If the lacerated urethra is widely separated or the bladder neck avulsed, traction applied to the end of the Foley catheter for two weeks will correct the deformity. The splinting catheter and suprapubic tube should be left in situ for two to three weeks, when the Foley catheter may be removed and voiding tried.

Perineal hematomas or swellings should be incised and drained at the time of the suprapubic exploration. Although ruptures of the bulbous urethra may be treated by external urethrotomy and drainage with good result, suprapubic cystotomy should also be performed, being a valuable safety valve in the majority of cases.

Patients with genitourinary trauma should be given multiple blood transfusions before, during, and after operation, as indicated, in addition to appropriate antibiotics and vitamins. Cases of renal injury should be studied periodically with repeat pyelograms. A patient who has sustained a ruptured urethra will require gentle periodic dilatation of the urethra, begun in the immediate postoperative period in the hospital and continued throughout life to minimize the formation of stricture.

Our Office Nurse

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"A pile driver is not a surgical instrument."

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Hand Injuries

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THE care of an injured hand is accompanied by considerations so important as to seem out of all proportion to the extent of the injury. A so-called minor hand accident will often cause the victim greater loss of time from work than if he had had a subtotal gastrectomy or cholecystectomy. Moreover, a resulting partial disability may plague the man all the rest of his life and produce a dislocation in his home economics and his place in the labor market which is never overcome.

Generally speaking, most patients with hand injuries recover. The major consideration is, how complete is the recovery and how protracted? The criteria of evaluation are the residual disability and the time required to secure the end result. These considerations must ever be borne in mind by the doctor planning the treatment of an injured hand.

The general practitioner, who is usually the first to see a hand injured in an accident, often will, and should, take entire care of the case. At other times he will wish to seek aid in managing the repair of deep structures, for successful repair of tendons, nerves, bones, and joints within the hand is sufficiently difficult and disappointing to tax the ability and patience of the most skilled specialist in the traumatic field.

First aid—If the doctor is fortunate enough to see the patient soon after the accident he will promptly apply the basic principles of the care of wounds.

Retracting, probing, or looking into the wound invites infection and must not be done. Moreover, cut tendons or nerves cannot be diagnosed in such a way. The wound should be covered at once and left covered. The first dressing should be removed only when the stage is set for definitive treatment either in the operating room or the doctor's office. A second dressing does not belong in first aid.

If the patient is to be transported or if a few hours must be lost before operative care can be done, one may be permitted to dust sulfonamide crystals into the wound or to give the patient 400,000 units of penicillin by injection. The value of these procedures may be argued but we have never observed any harm from such steps.

Antitetanus serum should be administered. This is often done by the first doctor to see the patient. The routine dose at many emergency departments is 1,500 units of A.T.S. This may not prevent

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tetanus from showing up later if the infection has been established in the wound, but will prevent death by attenuating the attack and permitting vigorous treatment of the disease.

Most men who have served in the armed forces have had A.T.S. or toxoid and a further dose of A.T.S. may produce severe sensitivity reactions. Such patients should therefore be given a booster dose of tetanus toxoid, 1 cc. by hypodermic injection, not the antitoxin.

Examination—After the wound has been covered, the doctor proceeds to examine the hand—*not the wound.* By so doing, the exact damage can be determined with great accuracy.

By testing each joint of each finger separately we may find which slips of flexor profundus, or flexor sublimis, or extensor tendons are functioning. If not functioning, we must assume that the tendon has been severed or its nerve supply destroyed. Since the long tendons have their muscle bellies in the forearm, a wound of the hand could not destroy innervation. Therefore the tendon proper must be damaged.

Damage to nerves in a hand may also be demonstrated surely by examining the hand, not the wound. The sensory distribution is well known to all. An insensitive area found over all or part of the median or ulnar nerve areas enables the examiner to say exactly which nerve is damaged, and how much. The small muscles in the hand will serve to double check the nerve lesion.

Roentgenograms should be made if any suspicion of fracture is entertained. These are made without removing the first-aid dressing and, to avoid needless moving of the patient, may be made en route to the operating room.

Having determined, by complete examination, just what damage has been done to deep structures, the physician proceeds to plan his campaign. If the injury is a soft tissue wound only, without damage to important deep structures, he will often assume complete care. If deep damage has occurred to tendon or nerve he will, in most cases, prefer to ask someone who is doing more of this sort of surgery to repair the damage. Even then, if a delay of several hours must ensue before special surgery could be instituted, he may have to handle the wound himself.

Care of the wound—The care of the wound consists of [1] cleansing, [2] debridement, and [3] covering. The same aseptic technic must be used as for an operation. The physician should be properly scrubbed, gowned, capped, masked, and gloved to approach the task. Assistants and anesthetics, as needed, should be available.

Not until the doctor is ready to go to work is the first-aid dressing removed. An assistant or nurse will hold the arm elevated and remove the dressing. The doctor then paints the skin up to, but not into, the wound, using whatever skin preparation he prefers. Draping is done with sterile sheet and towels. The surgeon then proceeds to cleanse the wound.

The wound is washed gently but thoroughly for about twenty minutes. A weakened solution of green soap and sterile water or sterile saline is excellent. White Castile soap will serve, or a bland detergent. Strong chemicals or antiseptics are never placed directly in the open wound, since they harm tissue cells and impede healing.

Debridement should be performed in a common-sense fashion. Dead, shredded, or devitalized fat, fibrous tissue, veins, and small flakes of bone are removed. A wide slicing debridement, as in a thigh, cannot be done in a hand without sacrificing tissue needed for repair of nerves or tendons.

Closing the skin—After patient cleansing and adequate debridement, the wound is closed. All raw tissue must be covered with epithelium to exclude infection and minimize granulation tissue with ultimate scar. Usually the edges can be approximated with silk or some such material. If the defect is so great that the edges will not come together, it may be possible to remove enough bone and soft tissue to permit closure without further impairing ultimate function.

If skin edges cannot be approximated even after beveling or removing tissue, grafting is necessary. Most general practitioners do not undertake grafting. In such cases, the wound should be covered with sterile dressing and immediate transportation to a plastic surgeon arranged.

It is good surgery for the general physician to suture the skin after treating the hand wound in the full knowledge that cut tendons and nerves are left inside. By so doing the wound is protected from infection until formal repair of deep structures can be arranged. The surgeon who sees the patient days later may reopen the wound without infection, if clean and healing by primary union. A delayed primary suture may then be done with reasonably good prospect of success.

Dressing—After closure of the wound, a pressure dressing is applied. Sterile gauze pieces may be fluffed up to make a generous layer and the whole is bound on with firm wrappings of flannelette or gauze bandage, so as to exert even, gentle pressure over the entire area, well beyond the wound. This dressing may be left untouched for seven to ten days as long as no evidence of infection appears. The fingers are checked later in the day to be sure that circulation has not been hampered.

Position of function—While the pressure dressing is being applied, the greatest care should be exercised to maintain the hand in good position. Left to himself, the patient almost always gets the hands into the worst possible position—the wrist slightly flexed, the fingers extended, and the thumb abducted like a monkey's. In this position even a moderate amount of movement is useless.

The correct position of function is opposite in every respect: The wrist must be extended in cock-up position, the fingers in semiflexion, and the thumb well around to the front but not too close to the hand,

so that the tip of the thumb can reach the tip of each finger. In this position even a few degrees of motion will be useful.

The doctor must be alert and faithful if the position is to be maintained. The injured hand must be rechecked almost daily and the splint and bandage readjusted as needed to force the hand to remain in correct position. The patient tends to let the hand droop into bad position.

Elevation—Elevation of the injured hand is worth while. A hand allowed to hang by the side for a few hours becomes swollen, bluish, puffy, painful, and stiff. Many weeks may be required to overcome a few hours of bad position and swelling.

While the patient is in bed, the hand is kept on a pillow, elevated all the time. Some physicians even tie the hand up to an intravenous standard. When the patient is up and around, the hand is carried well up across the chest in a light sling.

Amputations—Every hand is an individual problem. Consideration must be given to many factors, including the nature of the injury, the patient's age and sex, and the type of work he wishes to do.

Amputation may have been accomplished by the accident or the surgeon may amputate to remove parts not likely to be of further use to the victim. Considerable judgment and experience are required to assess permanent damage. A badly shattered finger certain to become stiff is best removed so that prolonged treatment will not cause stiffening and loss of function of the adjoining digits.

In performing an amputation, the doctor usually goes far enough back to operate through reasonably healthy tissue capable of good healing. The old dictum, "Save all the fingers you can," must be qualified to read "Save all the function you can." It is much better to amputate just behind the head of a phalanx or metacarpal than through the joint, so avoiding club ends.

Hemostasis must be obtained. A hematoma under the flaps may produce damaging fibrosis. The digital nerves will be dissected back about ¼ in. before being cut, in an effort to avoid painful neuromas. The flaps should be generous enough to allow for shrinkage and prevent tight stumps.

In the common guillotine or slice amputation produced by sharp machines, the bone is flush with the surrounding soft tissue. It is usually best to go about ¼ in. farther back and remove enough bone so that flaps can cover the end readily. The fat and fibrous tissue between skin and bone should be beveled to permit flaps to swing over nicely and cover the bone with a good cushion.

Unless very definite reasons exist, the other more elaborate plastic procedures such as the Thiersch graft from the forearm, or the pedicle graft from the thenar or dorsum of the thumb or abdomen are usually not worth the extra time and stiffness entailed. They often do not produce as good an end on the stump as hoped for.

The flexor and extensor tendons should not be sutured together over the end of the bone. A glance

at the structure of the finger and an elementary knowledge of the principle of levers make clear that all tendons are inserted at the base of their respective phalanges, not at the distal end. Thus a small movement of the tendon produces a large movement at the tip. If tendons are sutured over the end they become adherent to the end of the bone and do not slide; the phalanx is then firmly braced on both sides and cannot move.

Bones—Fractures in the hand must be reduced perfectly. In other parts of the body, such as arm or thigh, a position in which the bones are half on is acceptable, but in the hand we cannot accept even 1 mm. of variation. Anything short of perfect reduction as to angulation, side slip, or end-on position invites interference with extensor or flexor tendons and some permanent stiffness.

Tongue depressors are not good splints because they are straight. The position of function must never be forgotten.

Tendons—The details of technic employed in suturing cut tendons vary from surgeon to surgeon. The principles remain, however, unalterable.

Tendons and nerves should be sutured as soon as possible. The best time is right away. The only excuse for the much discussed delayed suture is fear of infection in cases which have not been seen by the surgeon until some hours have elapsed. If both flexor sublimis and profundus are severed, the sublimis will be removed, giving the sutured profundus more room to slide.

Tendons should be sutured in the correct anatomic arrangement. When multiple tendons are severed, as in cuts across the wrist, patience and a knowledge of anatomy are indispensable.

The suture material must be strong enough to withstand the pull of muscle in a strong man, even in his struggles when coming out of the anesthetic. Since the suture material must retain strength, absorbable sutures are never used. Catgut will not only weaken and break but excites pronounced cellular reaction during absorption; this reaction terminates as scar tissue which fixes the tendon firmly, causing permanent loss of function. Silk or nylon of the appropriate strength is perhaps best. Cotton, linen, or wire is preferred by some surgeons.

Rest in the correct position of function is essential and must be maintained until healing is strong enough to hold after the splints are removed. Rest should not be maintained beyond this period. Most surgeons insist on three to four weeks.

Nerves—The hand is one of the most satisfactory sites in which to perform nerve suture. Accurate repair is followed by gratifying recovery in a high percentage of cases.

Once again prompt repair is best. The only reason for postponement is fear of infection when delay has been unavoidable. The more anatomically perfect the apposition, the more complete the recovery. Great pains are taken to fit the ends gently and perfectly together.

Suture material is light because the nerve exerts no pull. A fine silk is most often used. The tiny stitches grasp the nerve sheath only and do not penetrate the body of the nerve. Interrupted stitches are used and as many are inserted as are needed to butt the ends together firmly and accurately, but gently. The pressure bandage and splint applied later will hold the hand so as to avoid pull on the reconstituted nerve.

Rehabilitation—Care is not complete unless the doctor plans for rehabilitation of the hand and the patient. This rehabilitation begins even before the first-aid dressing is applied and continues through the entire course. A few words of encouragement and optimism will go far to turn the patient's mental attitude in the right direction.

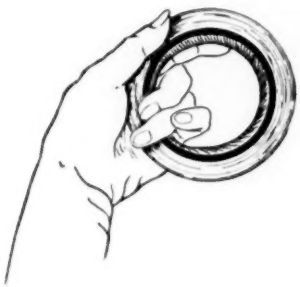
Rest for a few days will allow the reaction of trauma to subside and healing to start. Active movement is then encouraged. What the patient does under his own power is infinitely more valuable than passive movement carried out by someone else a few minutes each day.

The position of function must be maintained at all costs. Elevation has also been emphasized. Swelling cannot be tolerated. This is at first fluid, but soon clots and becomes a solid swelling or fibrosis. Edema must be eliminated in hours or days; otherwise it becomes permanent.

The uninjured parts of the hand and also the wrist, elbow, and shoulder must be watched and included in the active movements. It is amazing how much stiffness and ache can creep into a shoulder when an injured hand is carried quietly in a sling for a few days. Fibrosis is laid down in joint capsules, tendon sheaths, and all soft tissue.

Physiotherapy and occupational therapy are excellent adjuncts to the patient's own efforts, and should be enlisted promptly. In the early stages they help diminish swelling and maintain the tone of the tissues.

In later stages they keep the patient working faithfully on the problem and advancing day by day toward ultimate rehabilitation. However, the patient must not assume that the use of these aids relieves him of responsibility in his recovery.



Prepared for Modern Medicine

Special Considerations of Joint Injuries

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IN an orthopedic practice, patients are occasionally encountered with serious permanent joint disabilities which might have been avoided by proper early diagnosis and therapy.

According to folklore, a "sprain is worse than a break" and "ligaments do not heal as well as bones." These observations may well have arisen from the fact that torn ligaments are commonly not immobilized, as fractures are, for the duration of the healing period. Fractures are usually easily demonstrable by gross clinical and roentgen signs, but the diagnosis of sprains depends upon special methods.

Forced inversion of the foot, resulting in tearing of the fibers of the external lateral ligament, is one of the most common joint injuries. Moderate to severe swelling with local tenderness over the tarsal sinus, pain on weight bearing, and increased discomfort upon forced inversion are consistent findings. Routine anteroposterior and lateral roentgenograms of the ankle are commonly reported negative for fracture. This factor alone may lead to serious error in diagnosis.

When a sprain of the ankle appears severe in spite of the negative routine roentgenogram report, further inquiry about the injury is indicated. One should ask: Was the immediate pain exquisite? Did the patient feel something give or break? Was the injury accompanied by faintness, nausea, or vomiting?

If these symptoms have occurred or if the swelling and ecchymosis are greater than one would expect from a simple sprain, special roentgen studies should be made in the anteroposterior view with the ankle forcefully inverted. Local 1% novocain infiltration into the area of maximum tenderness, possibly general anesthesia, may be required for the procedure. The true injury may then be shown—a dislocation of the astragalus with complete disruption of the external lateral ligament and, not infrequently, tearing of the transverse fibers of the deltoid ligament (Fig. 1). This injury,

Fig. 1. Roentgenogram with forced version reveals subluxation of astralgus that is not recognized with routine roentgenograms.

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if casually treated, may result in permanent chronic subluxation of the ankle and major disability.

Simple strains without severe relaxation of ligaments can be handled by any of many forms of conservative management. When disruption of the lateral ligaments is enough to allow a subluxation of the astragalus on forced inversion, complete immobilization is necessitated in a plaster cast for six to eight weeks. If instituted early, recovery with healing of the torn ligaments can be achieved.

KNEE

The knee joint is subject to frequent trauma. Physicians are commonly aware of most knee conditions, and also of the appropriate treatment.

Ligamentous injuries—Commonly, because of pain, local or general anesthesia is needed to demonstrate the relaxation of the ligament, and this can be checked by comparing roentgenograms of the injured and healthy knees (Fig. 2).

Fig. 2. Anteroposterior view of the knee with forced abduction. The figure on the right reveals the increase in medial joint space due to relaxation of the internal lateral ligament.

Patellar chondromalacia—Chondromalacia of the patella is a primary fibrillary degeneration of the articular cartilage of the patella which may occur as a primary disease in a young individual, although more probably as the result of unrecognized trauma.

The history is usually one of chronic disability of the knee. There is usually pain in the region of the patella and transient synovitis after exercise. The most constant symptom is crepitus, which is often quite audible and can be palpated as the patella passes over the femoral condyles. Crepitus frequently begins after direct trauma to the knee and is almost a constant accompaniment to subluxating patella.

The crepitus can best be elicited when the supine patient, with thigh and knee fully flexed, extends the knee actively. Roentgenograms are of little value except for differential diagnosis (Fig. 3).

When the symptoms are severe enough to interfere seriously with normal activities and do not respond to rest and support, surgery is indicated. Adequate exposure to evert the patella is used. A chondrectomy, in which the fibrillated cartilage is excised, may be done. Complete patellectomy should be done if the lesion is extensive.

The pathologic changes are limited to the fibrillation of the cartilaginous surface of the patella. The underlying bone shows no appreciable change. If the disease

is of long standing, mirror-like changes may appear on the adjacent cartilage of the femoral condyles. This involved cartilage should also be removed. The postoperative care consists of immobilization in a posterior plaster splint for three weeks followed by support for another three weeks. Quadriceps exercise is of utmost importance.

SHOULDER

After an injury, shoulder joint disorders other than fractures or dislocations are frequent.

Supraspinatus tendinitis—In the normal process of abduction and rotation of the arm, the anatomy of the shoulder predisposes to wear and to attenuation of the musculotendinous cuff and biceps tendon. Minor strains may cause an inflammation of attenuated structures.

Pain on abduction and rotation of the arm is the classical symptom. The pain usually occurs in the arc between 60° and 120° in both elevation and abduction. Roentgenograms may reveal some calcification in the supraspinatus tendon.

Local infiltration with 10 to 20 cc. of 1% novocain may be given for treatment. Relief is prompt and may be permanent, but frequently a transient exacerbation appears after a few hours. Roentgen therapy is frequently quite satisfactory for this type of inflammation. If calcified deposits are present, surgical excision is a common and satisfactory form of treatment.

Acute subdeltoid bursitis presents the same findings, usually in a more acute episode, and responds to similar forms of treatment—novocain injection or roentgen rays.

Rupture of the musculotendinous cuff—Partial or complete ruptures of the musculotendinous cuff usually occur in middle-aged workingmen. The predisposing factors are the natural degenerative changes in the fibers of the tendon.

Forced muscular pull against sudden resistance or a fall in which the weight is caught on the outstretched arm or adducted elbow is the frequent precipitating cause. Complete rupture of the tendon results in an inability to elevate the arm in abduction actively, while passive abduction can be obtained, thus ruling out the possibility of adhesions of the joint.

When a patient has acute pain about the shoulder with a history of injury which may suggest a tear-

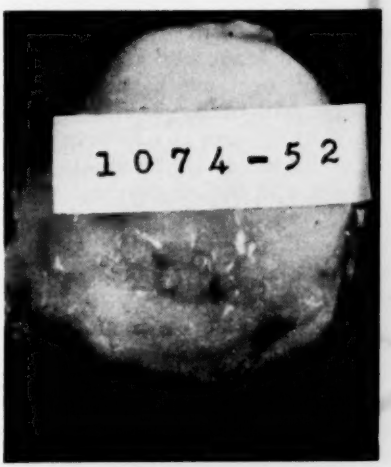

Fig. 3. Patellar chondromalacia. Note the marked fibrillation of the articular cartilage in comparison with the normal area above the marker.

ing of the supraspinatus attachment, local 1% novocain infiltrated about the greater tuberosity of the humerus to alleviate the acute pain will enable the examiner to determine whether active powers of abduction remain. If, with the anesthesia, the patient is able to elevate the arm up to 90°, one can feel satisfied that the damage to the musculotendinous cuff is not severe enough to necessitate operative repair. If, however, the patient is unable to elevate the arm beyond 30° to 40°, the tear of the musculotendinous cuff is probably severe enough to necessitate surgical exploration.

Sling support with the arm at the side is not usually effective, predisposes to periarticular adhesions which limit all shoulder motions severely, and results in greatly increased technical difficulty in later surgical repair, if such becomes necessary. However, most partial tears will heal under conservative management of rest and immobilization of the arm in a spica cast or an abduction splint in 90° of abduction and 60° of external rotation, with an exercise program from this position as pain and discomfort subside.

In cases of complete tear or when conservative treatment fails, operative repair is indicated. It is advisable to excise the outer portion of the acromion and sever the coracoacromial ligament to obtain more adequate clearance to the head of the humerus.

Periarthritis—Capsulitis, chronic adhesive subdeltoid bursitis, and periarthritis are terms used to describe a condition usually characterized by pain in the shoulder region, frequently radiating down the arm, which leads to progressive loss of scapulohumeral motion. This process is often precipitated by slight strains about the shoulder and is most common in women over 40 years of age.

The earliest findings are limitations of abduction and external rotation, chiefly because of muscle spasm, closely followed by loss of motions from pericapsular adhesions. Finally, frozen shoulder develops. This condition is of importance because of the prognosis.

The roentgen picture is usually negative except in the later stage when some moderate spotty decalcification of the humeral head is seen. The diagnosis is achieved by the history of pain, especially severe at night, the progressive limitations of motion, absence of definite local findings, and the presence of restrictions of scapulohumeral motion on passive tests.

In early stages, the frequent errors in diagnosis include subdeltoid bursitis, neuritis, and cervical radiculitis and arthritis. Periarthritis does *not* respond to novocain injections or roentgen therapy, as do acute bursitis and tendinitis, and such treatment is useless.

In the early acute phases, adequate sedation for pain, mild local heat, and active and gentle passive assisted stretching exercises at daily intervals are used. Active manipulation or excessively painful passive manipulations are definitely contraindicated.

In the chronic stage with a fro-

zen shoulder, after the acute painful stage has passed, manipulation under anesthesia can be employed, but only with great caution and on repeated multiple attempts. Only one group of adhesions is broken at each manipulation. The manipulations are done with the patient in the prone position. An assistant exerts a firm grip on the lateral border of the scapula to render the maneuver effective at the scapulohumeral joint, while the operator takes a short grip on the upper arm to reduce the possibility of a fracture of the surgical neck of the humerus. All maneuvers must be followed by daily active exercises.

The patient should be told that the disease is chronic and that recovery is always slow. Perseverance with the active exercise program is necessary. The prognosis, fortunately, is good for ultimate recovery in spite of slow progress.

POSTTRAUMATIC VASODYSTROPHY

We cannot conclude any discussion on joint injuries without mentioning one of the most serious complications. With unfortunate frequency after some rather trivial trauma to the hand, wrist, foot, or ankle, and occasionally to the shoulder, a serious course of events may develop.

Within a few days or weeks after a rather simple injury, such as a sprain or Colles' fracture, the patient may complain of an undue and frequently unexplained amount of pain. Associated with this complaint are swelling and gradual atrophy of the subcutaneous tissue with trophic changes in the skin. In cases involving the hand, the fingers tend to contract in flexion and the palmar fascia rapidly becomes adherent to the skin, not unlike an early Dupuytren's contracture. All the involved joints rapidly become stiff and painful on motion.

This peculiar reaction is the most common in emotionally unstable individuals who tend to have low pain thresholds. Roentgenograms made during the process frequently reveal spotty decalcification of the bones. In severe acute cases, the process is called Sudeck's atrophy. The condition may appear in all degrees of severity and is best described as a posttraumatic vasodystrophy.

Early recognition is not only an aid to treatment but of great value in prognosis, as recovery may take eighteen to twenty-four months and some possibility of permanent disability exists.

With early recognition, avoidance of constricting casts or bandages, elevation of the affected part, and support of the joints in a functional position are the important considerations. Relaxing vasomotor medications, such as Priscoline or Etamon, may be of some value when used early. Lumbar sympathetic or stellate ganglion blocks with novocain in the earlier stages have been of value; occasionally, sympathectomy is used as having a more permanent effect on the sympathetic vasospasm, particularly if the results from the blocks are good. In all cases, long periods of physical therapeutic rehabilitation are needed after the acute phase of the process has subsided.

Prepared for Modern Medicine

Soft Tissue Injuries of Lower Limbs

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CLOSED trauma of the ligaments, muscles, and tendons in the lower extremity falls into three groups: contusions, sprains, and strains. A *contusion* is an injury of soft tissues from direct violence, usually in the presence of intact bone and skin. A *sprain* is generally considered to be a rupture or avulsion of a ligament, partial or complete. A *strain* is a similar traumatic separation of muscle or tendon fiber.

From the point of view of pathology, the natural history of contusions, sprains, and strains is basically the same. A hematoma forms at the point of injury as a result of bleeding from arterioles. Within hours the hematoma is invaded by phagocytes and fibroblasts, devitalized tissue is gradually carried away, and repair is effected by scar.

This concept has been developed largely by inference but is supported by some experimental studies and occasional opportunities for direct surgical observation. The time required for this process varies naturally with the degree of injury and the age and health of the tissues.

Under ideal conditions, divided tendons can be demonstrated to increase in tensile strength after an injury at a predictable rate which can be expressed almost as a logarithmic curve.

Treatment is based on this understanding of the natural processes of healing. The progressive increase in tensile strength of an injured muscle, tendon, or ligament must not be interrupted by too early active motion but, at the same time, atrophy must be prevented as much as possible. A middle course must be steered between motion and immobilization.

Neglect of a soundly based, rational plan of therapy can result in permanent disability from apparently minor injury.

Four general principles apply in the immediate treatment of all contusions, strains, and sprains. These are: [1] *Cold* will constrict the arteriolar bed and diminish hematoma formation. [2] *Compression* checks active bleeding in the injured tissues and disseminates hematomas already formed. When compression is used, absorption of dispersed hematomas will be more rapid and the resulting scar will be a thin and pliable one rather than a massive (Fig. 1). [3] *Elevation* of the injured part will decrease edema formation by simple hydrostatics. [4] *Rest* usually is imposed naturally by pain; obviously, the more a recent injury is aggravated, the greater will be the disability in both time and degree.

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The sooner after a contusion, strain, or sprain that these principles are applied the better. After a few hours, cold is of little value but compression and elevation are useful for several days. If the patient is aged or has peripheral vascular disease, cold and compression must be used with care, if at all.

When danger of further bleeding in the damaged tissues has passed, in twenty-four to forty-eight hours after injury, heat rather than cold is used to dilate peripheral blood vessels and thus speed the absorption of waste products at the site of injury. Massage has a place at this point, and careful, guided exercise within the limits imposed by pain is of the greatest value. Each case must be studied carefully with regard to the time at which immobilization or rest ceases to aid the natural processes of healing and becomes an impediment.

Occasionally, in severe injuries of muscle, tendon, and ligament, a fifth principle applies, the surgical restoration of continuity by direct *open reconstruction.* Such operative procedures at times are best done immediately after the injury, particularly when abrasions of the overlying skin are present which

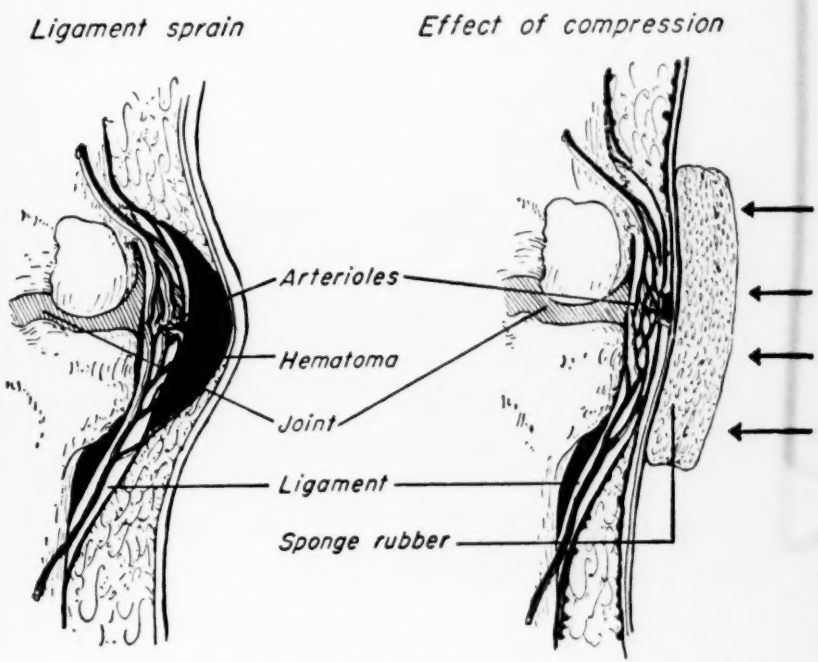

Fig. 1. Effect of compression on typical ligament sprain

may become a source of sepsis. More often, surgery is deferred for a few days until the patient has recovered from the immediate effects of the injury.

No two injuries and no two patients are alike and the following principles must be modified to fit the particular injury. At the same time, general application can be described for certain common injuries:

Sprain of the ankle—An ankle sprain is a partial and at times complete tear or avulsion of the tibiofibular, lateral collateral (calcaneofibular and talofibular), or medial collateral (deltoid) ligaments or combinations of these ligaments.

Fracture must be ruled out in the great majority of ankle sprains. This can be accomplished with certainty only by roentgenograms. It is better to make 50 "negative" films than to miss 1 potentially disabling fracture.

Fig. 2. Sponge rubber and elastic cotton bandage applied. Beveled aperture cut in rubber prevents excessive pressure on malleolus.

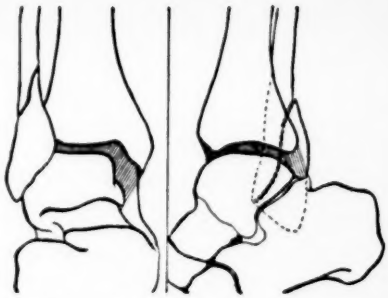

Fig. 3. Widened joint mortise with fracture in distal fibula. Note wide space between astragalus and medial malleolus.

When a patient is seen immediately or within a few hours after ankle sprain, little can be accomplished by way of precise diagnosis. It is sufficient to rule out bone injury by roentgenograms and to establish which side of the ankle is principally involved. A sponge rubber compression dressing of the type known commercially as "Tan open cell sponge" can be applied (Fig. 2). When this is compressed to half its thickness, a pressure of 40 to 60 gm. per square centimeter of skin is produced. The limb is then immersed in ice-cold water. After twenty to thirty minutes in the cold bath, the compression dressing is replaced and the patient is advised to elevate the ankle above the level of the heart as much as possible during the next twenty-four hours.

Crutches of the proper length are provided. Most patients need some instruction in crutch walking. The most important point is the avoidance of weight bearing on the axillae. Brachial plexus injury producing "crutch palsy" of several months duration is not uncommon.

Figure 4

The next day, after removal of the compression dressing, the particular ligaments injured and the degree of involvement can be determined and graded with considerable accuracy by palpation and gentle manipulation. A grade I sprain is the least degree of injury to a ligament which can be classified as a sprain. Grade IV is complete rupture of the ligament involved. Most sprains fall into groups II and III. Such grading is of considerable prognostic significance. For example, a college football player with a grade II sprain of the anterior tibiofibular ligament, seen immediately after injury and treated as outlined, will be ready to resume sport in eight to nine days. A similar sprain in a middle-aged saleswoman will take longer to heal.

When the likelihood of further bleeding at the site of the injury has passed, that is, after twenty-four to forty-eight hours, cold can be replaced by heat. This can conveniently be applied with hot towels or hot baths such as the whirlpool bath. Diathermy should never be used on injured joints since effusion very often follows and disability can be prolonged. Gentle centripetal massage of the effleurage type is valuable at this point in promoting blood and lymphatic flow. Weight bearing should not be permitted until possible without pain.

When the history is one of considerable twisting violence as in skiing and automobile accidents, and when tenderness over the involved ligaments is marked, the possibility of grade IV sprain or complete rupture must not be forgotten. The most frequently completely ruptured ligament system in the ankle is that binding the tibia and fibula together. When this is avulsed, the joint mortise usually is widened (Fig. 3). There is often an associated fracture of the fibula, but this is of much less potential consequence than the ligament injury. It is important to treat the widening of the mortise, otherwise an unstable joint and subsequent traumatic arthritis are likely to occur.

Therapy ideally consists of open reduction and bolting or screwing (Fig. 4) the fibula to the tibia for three to four months. The widened joint mortise can be treated by immobilization in snug plaster but such immobilization bears a risk of pressure sores and recurrence of the widening as edema subsides. Also, immobilization in plaster produces atrophy of the leg musculature and stiffness of the joint.

The medial and lateral collateral ligament systems can also be completely ruptured in violent tor-

sion injuries. Such rupture is usually associated with rupture of the tibiofibular ligaments. Here again, surgical exposure and restoration of continuity is the best treatment and is essential when the torn ligaments have become infolded into the joint.

There is no objection to immobilization in a light plaster boot in addition to a compression dressing for certain severe grade II and grade III ligament injuries. The patient will be grateful for the relief of pain thus afforded. This immobilization must not be continued for more than a few days if atrophy is to be avoided.

Procaine infiltration has been advocated by many in the past ten to fifteen years in the treatment of sprains of the ankle. It does not promote fibroblast formation and the removal of the protective aspect of pain may well allow the injury to become more severe. The use of procaine is based on a concept of Leriche and his school that change in vascular tone is followed by edema and pain which in turn produce further change. The theory is that if this vicious circle can be broken, complete relief of pain and restoration of function will follow. This concept applies and procaine infiltration is indicated only in occasional grade I sprains in which the degree of pain is obviously far greater than the degree of ligament damage.

Sprain of the knee—As in sprains of the ankle, no accurate diagnosis can be made for knee sprains without roentgenograms. These should include anteroposterior, lateral, and tunnel views. Particular attention should be paid to the tibial spines, avulsion of the tips of which can easily be overlooked. Examination should include determination of effusion and laxity in the medial collateral, lateral collateral, and cruciate ligaments (Fig. 5).

Lateral and medial laxity is determined by manipulation of the fully extended tibia on the femur with the examiner's left hand supporting the condyles of the femur and his right hand at the ankle or heel. Laxity of 15° or more, compared with the opposite uninjured knee, together with doughy edema of the anterior and lateral aspects of the joint without the characteristic demarcated sensation of fluid within the joint, is very strong evidence in favor of complete rupture of the medial or collateral ligament and severe sprain of the anterior cruciate ligament.

If these two signs are present, further examination under general anesthesia should be done within a few days and anteroposterior roentgenograms be made with the joint in normal full extension and at the limit of abduction or adduction as the case may be. If, under these circumstances, the tibial plateau tilts more than 15° to 20°, exposure and repair of the injured collateral ligament should be done without delay. Conservative treatment of knee injuries of this degree is not as satisfactory as precise surgical restoration.

The compression dressing for ligament injuries of less than grade IV severity in the knee consists of

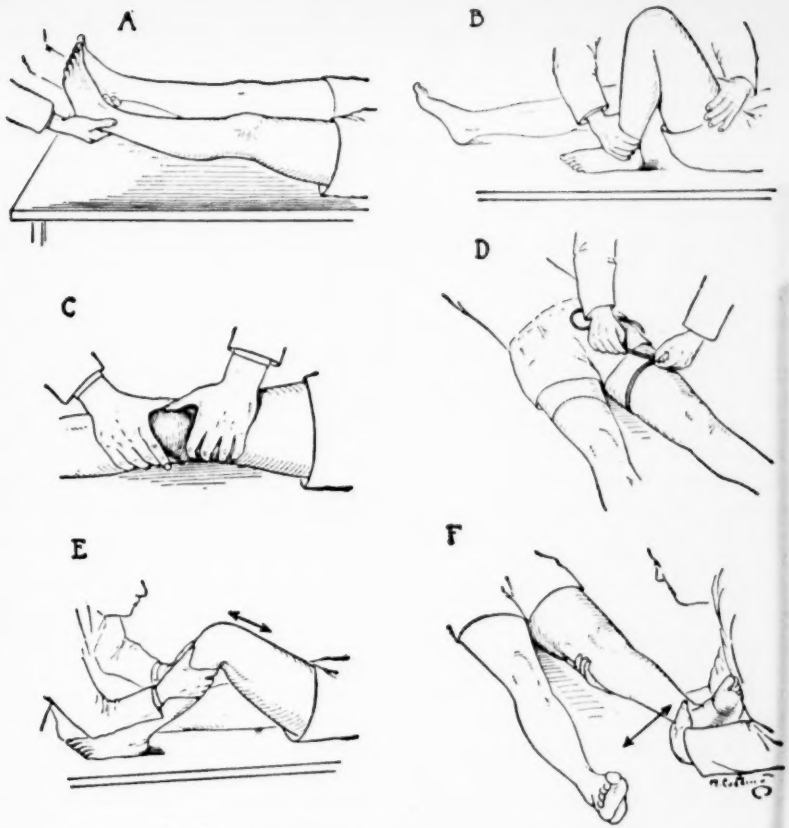

Fig. 5. BASIC STEPS IN EXAMINATION OF THE KNEE

The subject is supine and completely relaxed. All steps are first done on the uninjured leg.

A] Inspection and determination of extension.

B] Determination of active and passive flexion not carried beyond the point of pain.

C] Palpation for fluid. Pressure on the suprapatellar pouch drives small quantities of fluid downward. The right index finger is shown about to compress the anterolateral aspect of the joint, producing a fluid wave palpable by the thumbs and left hand.

D] Determination of muscle atrophy. The circumference of the thighs is measured at the same level.

E] Determination of cruciate ligament laxity. The knee is flexed at 90°. The examiner's forearm presses firmly against the lower tibia while both hands grasp the leg, manipulating it in the sagittal plane.

F] Determination of collateral ligament laxity. One of the examiner's hands rests on the table and grasps the femoral condyles. The other grasps the ankle and manipulates the extended knee in the coronal plane.

sponge rubber applied by elastic cotton bandages to the anterior, medial, and lateral aspects of the joint with an aperture cut in the rubber for the patella. A sponge rubber compression dressing for the knee is illustrated in Figure 6. A beveled aperture has been cut for the patella and infrapatellar tendon.

Figure 6

If such a dressing is applied immediately after an injury and the other principles of *cold, elevation,* and *rest* are observed, a significant effusion rarely occurs. Apparently, this dressing creates an intraarticular compression greater than the filtration pressure of synovial effusion. Such dressings must be applied with caution, if at all, in individuals over 35 and in patients with any evidence of peripheral vascular disease.

When effusion is so great that the patella is lifted, aspiration should be performed. Though a simple procedure, this should never be done casually in an office or home but only after the same preparation and safeguards have been observed as for an arthrotomy.

Fractures of the tibial plateau without displacement often present a difficult problem in differential diagnosis. These may not be seen in ordinary roentgen views. The presence of droplets of marrow fat in aspirated fluid is a valuable clue.

As in ankle sprains, heat in the form of hot baths can be instituted twenty-four to forty-eight hours after injury. Quadriceps exercises, first of the "setting" type and, later, when pain is subsiding, of the progressive resistance type, are extremely important. The immobilization of ligament sprains of the knee in plaster has little to commend it. Atrophy, particularly of the vastus medialis, is almost certain to occur and may require months of vigorous, progressive resistance exercise to overcome. Crutches should be used until weight can be borne without pain.

Even in the young and healthy, knee ligament sprains do not heal rapidly. In college football players three weeks is the minimum period of treatment before play can be resumed after a player has sustained a sprain of grade II severity.

The differential diagnosis between internal derangement and ligament sprain is a frequent problem in knee injuries. Conservatism is the keynote. Most internal derangements are accompanied by some ligament sprain and it is well to wait until the sprain is healed before a definite diagnosis is established and arthrotomy recommended.

Only a deranged knee which is irreducibly locked and has little associated sprain should be operated upon promptly.

Valuable clues in establishing the diagnosis of internal derange-

ment are obtained from the history, which is usually one of abduction and external rotation of the tibia on the femur, from the localization of pain to the medial or lateral side of the joint, and from roentgenograms, which should always be made to rule out osteochondritis dissecans and other bone abnormality.

Hamstring spasm can simulate a locked knee but this condition can usually be relaxed by means of gentle physical therapy.

It is wisest not to remove an injured meniscus after the first injury but to await further symptoms. A test of function such as an obstacle course on rough ground may be of help in forcing the issue in certain cases.

Once the operation has been determined upon, a program of quadriceps setting and progressive resistance exercise should be instituted until the quadriceps and the hamstring muscles have reached the maximum development that is possible in the presence of the derangement.

Immediately after operation, exercises should be resumed and continued until muscle power in both the extremities is equal and normal.

The operative treatment of internal derangement of the knee is not to be undertaken lightly. Special instruments, experience, and skill are required for good functional results.

Muscle rupture in the calf—Rupture of the plantaris muscle, usually at the point of attachment of the long tendon to the short muscle belly in the upper calf, occurs most often in vigorous men in the third, fourth, and fifth decades of life. The usual history is that of a sudden severe pain while the subject is playing tennis or handball.

The pain is often compared with the sensation of a bullet striking the calf. Tenderness occurs across the midportion of the bulge of the calf musculature and the circumference of the calf is slightly greater than that of the normal opposite side. Plantar flexion of the foot is normal in power but painful.

Treatment consists of the application of the principles of *cold, compression, rest,* and *elevation* as dictated by the severity of the patient's symptoms and signs. Often no more than a piece of felt beneath the heel to relax tension on the calf musculature and an Ace bandage will be required for treatment.

In others, crutches and a few days of bed rest will be found necessary.

Thrombophlebitis occurs in the involved extremity in an appreciable number of patients with this injury. Progressive edema, pain, and tenderness despite adequate treatment are indications for heparinization and possible femoral vein ligation.

Eventual disability from the rupture itself does not occur, since the muscle serves no useful purpose in man.

The same forces in the same age group can produce varying degrees of strain of the gastrocnemius in

the lower calf at the musculotendinous junction. The same treatment is indicated.

Complete rupture is not an uncommon occurrence and requires prompt precise surgical restoration and immobilization with the foot plantar-flexed and the knee flexed for several weeks. Despite this prolonged immobilization, results are as a rule very good. Minor trauma producing rupture of a muscle or tendon should raise the question of syphilis.

Figure 7

Contusion of thigh—Blows on the thigh are common in athletes indulging in any contact sport such as football or hockey, and the results are known in athletic circles as charleyhorse. Treatment follows the principles outlined, but compression is difficult to achieve because of the large muscle mass that is involved.

Short-wave diathermy is the only modality which will deliver heat to the depths of an injured quadriceps or hamstring muscle. Massage must be gentle lest the healing contusion become irritated. Aspiration of hematomas in the thigh musculature is not rewarding except in most unusual circumstances since the blood at the site of an injury apparently clots very rapidly.

Ordinarily in the course of events, if the proper treatment is followed, normal function should follow a grade II contusion of the thigh musculature in a young man in two or three weeks. If swelling, tenderness, and limitation of muscle function persist, myositis ossificans traumatica should be suspected. This can first be seen in roentgenograms made with a soft tissue technic as a fluffy calcific deposit three to four weeks after the injury has occurred. No change in therapy is indicated, but disability will be prolonged. Eventual function is almost invariably normal. Sometimes the roentgen shadow of myositis ossificans (Fig. 7) can be confused with that of bone tumor, but the diagnosis can always be established by an adequate history of trauma. Operative removal of the calcific mass is almost never necessary and under no circumstances should be attempted within a year or two of the injury lest further calcific deposit occur. In Figure 7 is shown a case of mature myositis ossificans traumatica several months after a blow on the anterior aspect of the thigh. The patient is a young athlete who has no symptoms. Function of the extremity is normal.

Prepared for Modern Medicine

Amputation in Acute Trauma

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GANGRENE caused by occlusive vascular disease is usually slow in onset and the surgeon's judgment is not taxed in reaching a decision to amputate. However, after abrupt interruption of the blood supply to a limb by acute trauma, potential gangrene causes great concern.

The surgeon who first treats a mangled extremity must decide whether to amputate or attempt reconstruction. Under such circumstances the greatest conservatism should be exercised.

The indications for amputation after an acute injury are [1] potential gangrene from abrupt interruption of the blood supply and [2] irreparable damage to multiple structures in the presence of an adequate vascular state. Extensive simultaneous damage to bone, joint, muscle, tendon, and nerve may make the reconstruction of an extremity to any functional state a surgical impossibility, even if the blood supply is adequate. This combination of trauma is most often seen in a finger and this indication applies only to digits.

Immediate amputation of a major extremity should be done only when absolutely all blood supply to the part distal to the site of injury can be definitely demonstrated to be severed. If any doubt exists, an attempt should be made to salvage the extremity. Amputation can always be done days or weeks later, and the recovery of an extremity that appears hopelessly damaged is at times surprisingly good.

Type of amputation—When the trauma is sufficient to indicate amputation, the surgeon must decide what type to use. The choice lies between [1] open amputation and [2] closed amputation at the site of election. The choice is determined by the probability of infection. If there is any probability of infection, open amputation should be done.

The principal factors in reaching this decision are [1] the circumstances of the injury and [2] the interval of time between the injury and the institution of treatment. An individual with a severely comminuted compound fracture and complete severance of blood supply from an accident on a country road, arriving for treatment sixteen hours later, obviously is no candidate for a closed amputation because of the high probability of infection. Any procedure but open amputation to permit drainage would be improper. On the other hand, a patient who receives a sharply incised wound from clean machinery, with complete blood vessel severance, and who reaches medical care in the first hour or

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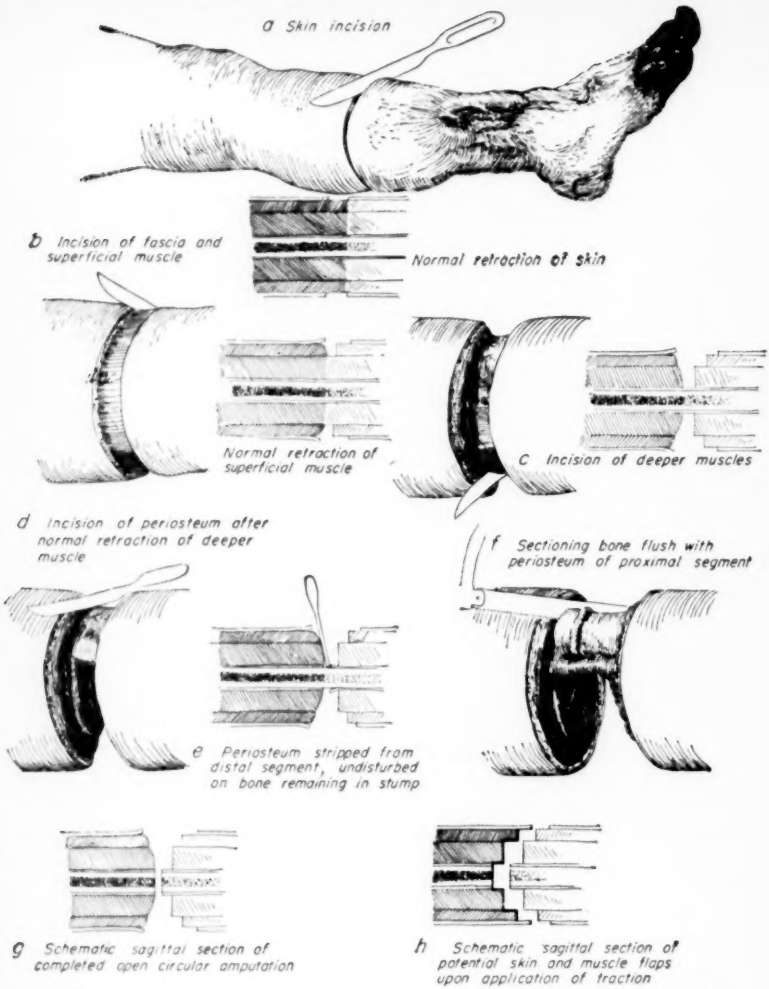
a Skin incision
b Incision of fascia and superficial muscle
Normal retraction of skin
Normal retraction of superficial muscle
c Incision of deeper muscles
d Incision of periosteum after normal retraction of deeper muscle
e Periosteum stripped from distal segment, undisturbed on bone remaining in stump
f Sectioning bone flush with periosteum of proximal segment
g Schematic sagittal section of completed open circular amputation
h Schematic sagittal section of potential skin and muscle flaps upon application of traction

From Cole, W. H., Operative Technic in General Surgery. Courtesy of Appleton-Century-Crofts, Inc.

Fig. 1. Technic of open circular amputation

two, runs very little chance of infection and may be saved much time by a closed amputation.

This basic surgical principle has not been abrogated by the array of antibiotics available, and no drug can compensate for poor surgical judgment. In any case of doubt, the patient should be given the benefit of the safety of an open amputation.

There are two types of open

amputation: [1] the open circular and [2] the open flap.

The open circular (guillotine is a poor term) amputation is a two-stage procedure. The first phase entails removal of the damaged part of the extremity. A second operation, consisting of closed re-amputation at the site of election or a plastic closure of the stump resulting from the open circular amputation, will be necessary at a later date.

Technic of open circular amputation—To perform an open circular amputation (Figs. 1 and 2), a circular incision is made through the skin at the lowest level compatible with viable tissue. The incision need not always be transverse to the long axis of the extremity. If necessary to preserve skin length, the incision may be diagonal to the long axis of the extremity or may be racquet shaped.

The skin is allowed to retract and the fascia is cut in a circular manner at the level to which the skin has retracted. The superficial layer of muscle is then incised at the margin of the fascia and allowed to retract. The deeper muscles are incised at the line to which the superficial muscles have retracted and are allowed to retract. Next the periosteum is cleanly incised in a circular manner at the level of deep muscle retraction and the bone is sawn through at this level.

The nerves are cut short and permitted to retract into fascial planes. Large nerves are transfixed and ligated immediately proximal to the point of section to prevent bleeding from their artery. Large vessels are transfixed and ligated, and smaller vessels are tied with plain catgut.

The complete cross section of the extremity is left open. In this operation, the leg is not "chopped off" as with a cleaver. The open circular amputation correctly executed produces a potentially inverted cone when traction is applied to the skin. No flaps are left to interfere with drainage or trap infection.

Postoperative care of open circular amputation—Consistent and meticulous postoperative care is of greatest importance to the success

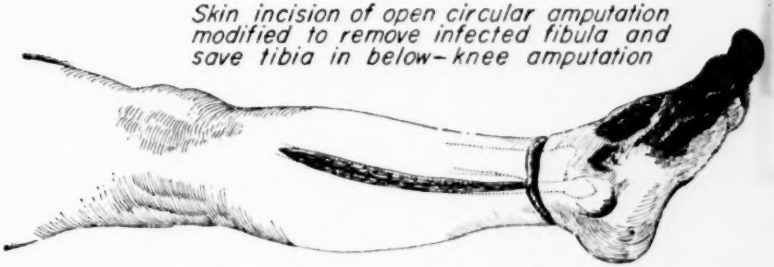

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Fig. 2. Modified open circular amputation

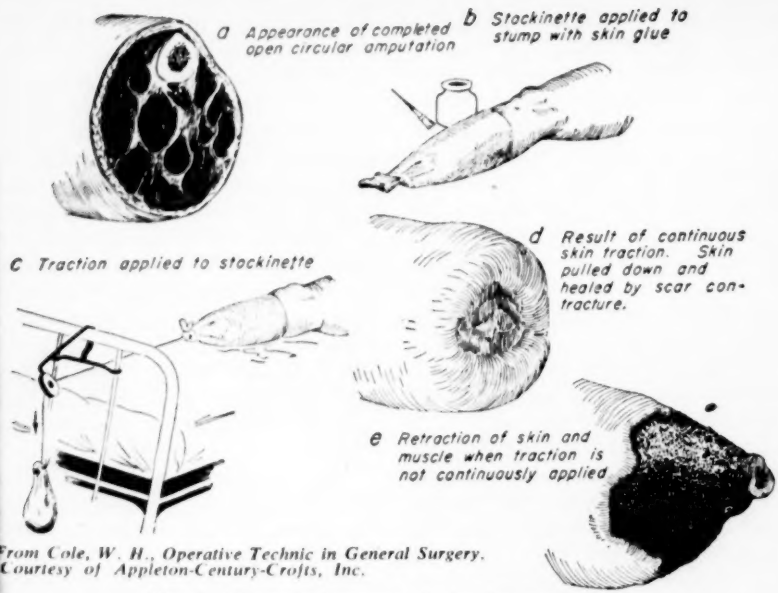

a Appearance of completed open circular amputation
b Stockinette applied to stump with skin glue
c Traction applied to stockinette
d Result of continuous skin traction. Skin pulled down and healed by scar contracture.
e Retraction of skin and muscle when traction is not continuously applied
From Cole, W. H., Operative Technic in General Surgery. Courtesy of Appleton-Century-Crofts, Inc.

Fig. 3. Postoperative care of circular amputation

of an open circular amputation (Fig. 3). Continuous skin traction is absolutely essential. It must be applied before the patient leaves the operating table and be maintained continuously.

Traction is easily effected by applying a suitable length of sterile stockinette over the stump from the level of the lowest remaining joint and projecting 12 in. below the end of the stump. Traction is applied by folding up the overhanging length of stockinette and cinching a cord about it. Weights are then hung from the cord over a pulley. To change dressings, the traction can be temporarily released and the stockinette rolled back over the end of the stump. When traction is maintained continuously from the completion of the operation, the potentialities of the concave cross section of the extremity are fully developed. The skin, because of elasticity, is gradually pulled down over the muscles, the bone end becomes covered by granulation tissue, and the skin margin is closed by scar contracture.

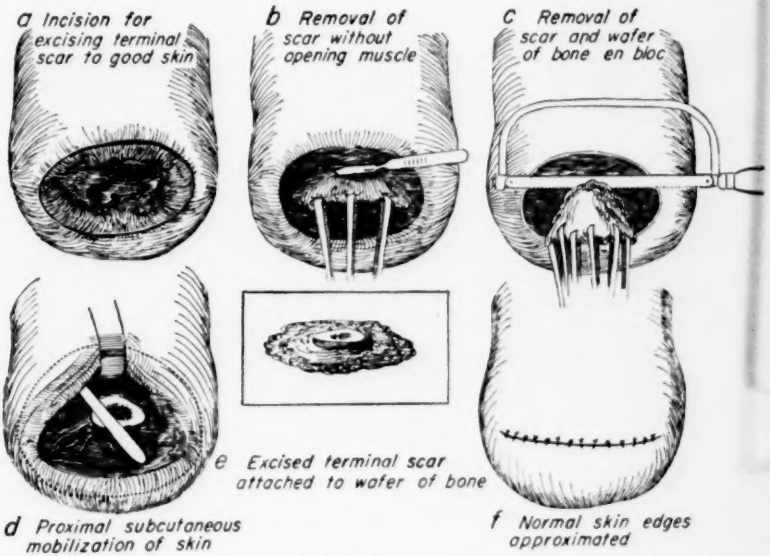
When skin traction is not constantly applied, the potentially concave cross section of the leg becomes a greatly exaggerated convex cross section, with 2 to 3 in. of uncovered bone protruding and a large collar of granulation tissue intervening between the constantly retracting skin margin and the bone end. Such a neglected stump necessitates reamputation at a higher site with unwarranted sacrifice of ultimate length.

Closure of open circular amputation—The second stage in preparing the open amputation for a prosthesis consists of covering the end of the bone by healthy pliable skin with good circulation and normal sensation. The stump is usually ready for closure six to eight weeks after the initial amputation.

Ideally, the bone end should be scarred over and no drainage be present at the time of plastic closure. However, even though a small area of granulation tissue persists, the tissues will tolerate surgical closure if the skin margins are not red or edematous. Before closure is attempted roentgenograms of the bone end should be obtained to determine whether sequestration is occurring. If so, closure should be delayed until a reasonable period after removal of the sequestrum.

The technic of plastic closure is simple (Fig. 4). The cicatrix at the stump end is excised to healthy skin, without opening muscle planes. If the scar is adherent to the bone margin, a thin wafer of bone may also be removed. The healthy skin is then undermined in the subcutaneous plane to obtain enough slack to effect closure of the margins without tension. The margins are then closed over the bone end with interrupted sutures. Again postoperative traction may be valuable to relieve tension.

If the stump is too long, a formal closed amputation should be

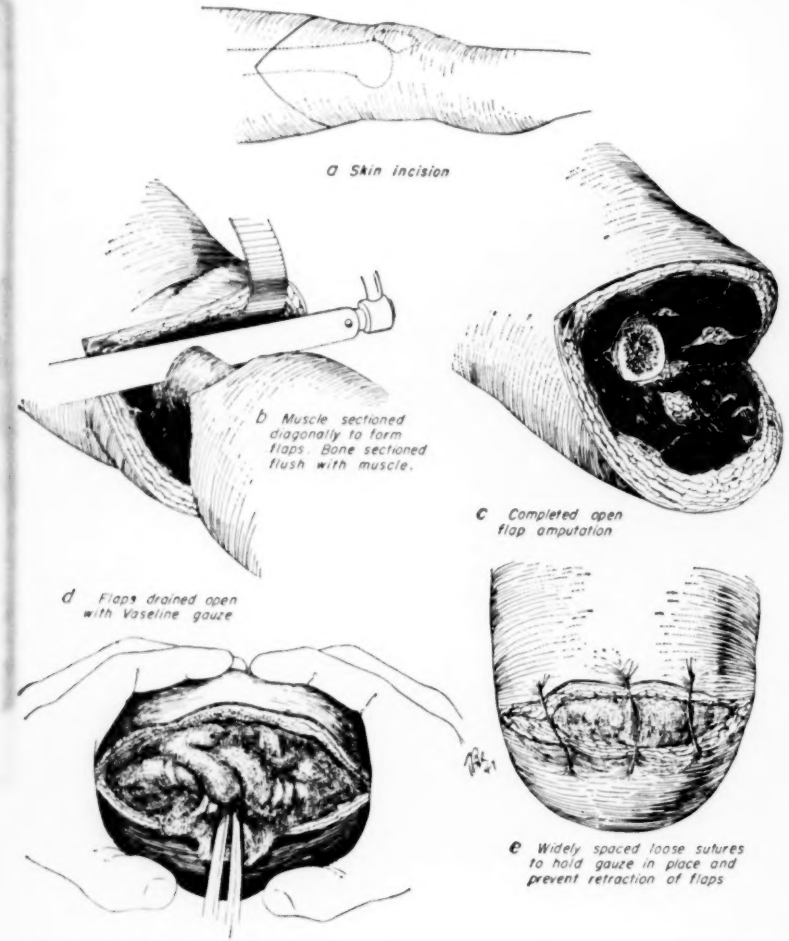

a Incision for excising terminal scar to good skin
b Removal of scar without opening muscle
c Removal of scar and wafer of bone en bloc
d Proximal subcutaneous mobilization of skin
e Excised terminal scar attached to wafer of bone
f Normal skin edges approximated

From Cole, W. H., Operative Technic in General Surgery. Courtesy of Appleton-Century-Crofts, Inc.

Fig. 4. Technic of plastic closure

done at the most suitable site for a prosthesis.

Open flap type of amputation—The open flap type of amputation is most applicable to an extremity in which one bone is centered in a mass of muscle with an even distribution of the muscle mass on all sides, such as the thigh or the arm (Fig. 5). Open amputations through the hip or shoulder should, if possible, be open flap amputations. Traction cannot be successfully applied close to the torso.


a Skin incision
b Muscle sectioned diagonally to form flaps. Bone sectioned flush with muscle.
c Completed open flap amputation
d Flaps drained open with Vaseline gauze
e Widely spaced loose sutures to hold gauze in place and prevent retraction of flaps

From Cole, W. H., Operative Technic in General Surgery. Courtesy of Appleton-Century-Crofts, Inc.

Fig. 5. Open flap amputation and closure

Duckbill flaps of skin, fascia, and muscle are cut en bloc; muscle is cut on a diagonal progressively more proximal than skin. Fascial planes are not opened. Bone is sectioned transversely to the long axis.

The flaps are drained open, being approximated loosely with a few slack sutures over petrolatum gauze for drainage. In absence of infection, flaps are permitted to fall together or early secondary closure is done. At any sign of sepsis the flaps must be widely opened.

The stump resulting from a successful open flap amputation is often a poor one, with redundant muscle, unsuitable for good use of a prosthesis. This type of open operation does not always do away with need for a second operation. Additional risk of complications as compared to the open circular type must be carefully weighed.

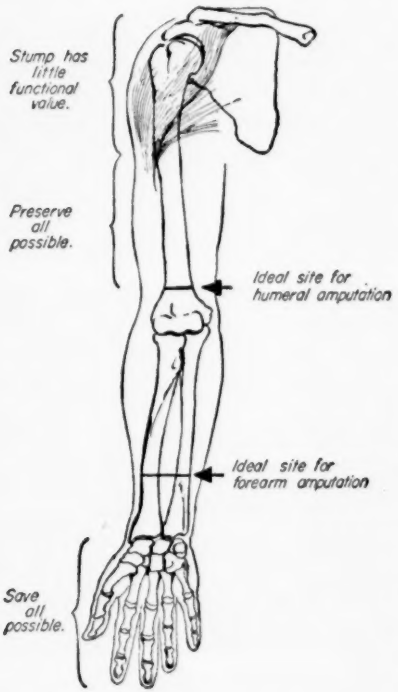

Stump has little functional value.
Preserve all possible.
Ideal site for humeral amputation
Ideal site for forearm amputation
Save all possible.

Fig. 6. Arm amputation sites

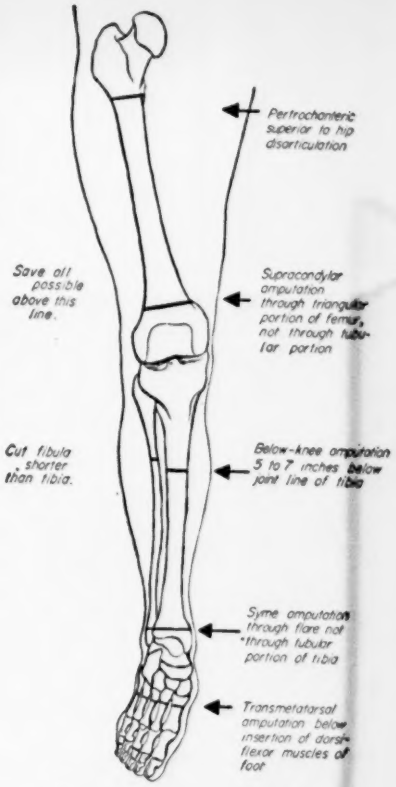

Pertrochanteric superior to hip disarticulation
Save all possible above this line.
Supracondylar amputation through triangular portion of femur, not through tubular portion
Cut fibula shorter than tibia.
Below-knee amputation 5 to 7 inches below joint line of tibia
Syme amputation through flare not through tubular portion of tibia
Transmetatarsal amputation below insertion of dorsiflexor muscles of foot

Fig. 7. Leg amputation sites

Sites for closed amputations—The ideal amputation sites in both the upper and the lower extremities are the best functioning levels for which a satisfactory prosthesis is available (Figs. 6 and 7). Cer-

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*Clein, Norman W.: Cow's Milk Allergy In Infants, Ann. Allergy 9:195 –1951

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tain levels of amputation, even though length is preserved, do not tolerate a prosthesis well.

Errors in the selection of the best site for amputation are most often made when a portion of the *foot* is removed. The surgeon is inclined to save all possible, without regard to skin coverage, function, and suitable stump for prosthesis.

In removal of toes, a single small toe should never be saved; it is in the way and has no functional value. If the great toe and 3 others must be removed, all toes should be excised. However, the great toe should always be preserved when possible, even though all other toes must be sacrificed, because of the value for walking and take off.

The only satisfactory amputation through the foot is the transmetatarsal. The anterior tibial, posterior tibial, and peroneal muscles do not lose the normal attachments to the tarsus. Consequently, the stump is under good muscle control, is well balanced, and does not go into a fixed deformity. The stump requires only a rubber or plastic filler in the shoe.

Any amputation proximal to the site of insertion of the muscles which dorsiflex the foot leaves a stump in which the muscle balance is destroyed. Such a stump gradually goes into a fixed equinus and varus deformity because of lack of opposition to the strong posterior calf muscles. For this reason, the classical Lisfranc or Chopart amputation is not satisfactory. The Lisfranc or Chopart stump goes into fixed equinus, and painful calluses and ulcers appear at the point of pressure. No prosthesis is satisfactory and the gait is unsteady and painful.

If adequate tissue is not available for a transmetatarsal stump, a Syme amputation should be done. The tibia and fibula are sectioned through the flared ends, below the inferior tibiofibular ligament and about 1 cm. above the lower articular surface of the tibia. The weight-bearing skin of the heel is turned over the end of the bones to produce a stump in which weight is borne directly on the end.

The Syme stump is the most satisfactory amputation of the lower extremity short of a well-balanced foot stump. The prosthesis does not go above the knee and the great length of the stump makes it possible for a patient to do simple things without crutches.

The Syme amputation is not suitable for a woman because the prosthesis is bulky at the ankle and conspicuous. It should also be avoided if the patient has circulatory inadequacy as the heel flap may slough or be cyanotic and painful.

The Pirogoff amputation has no functional advantages over the Syme amputation and presents several disadvantages. The additional length resulting from the presence of a portion of the os calcis does not leave room for good ankle mechanism in the prosthesis. In addition, the amputation is osteoplastic, requiring union of a portion of the os calcis to the tibia. This union may and often does terminate in malposition.

The site of election for amputation through the *leg* varies with the

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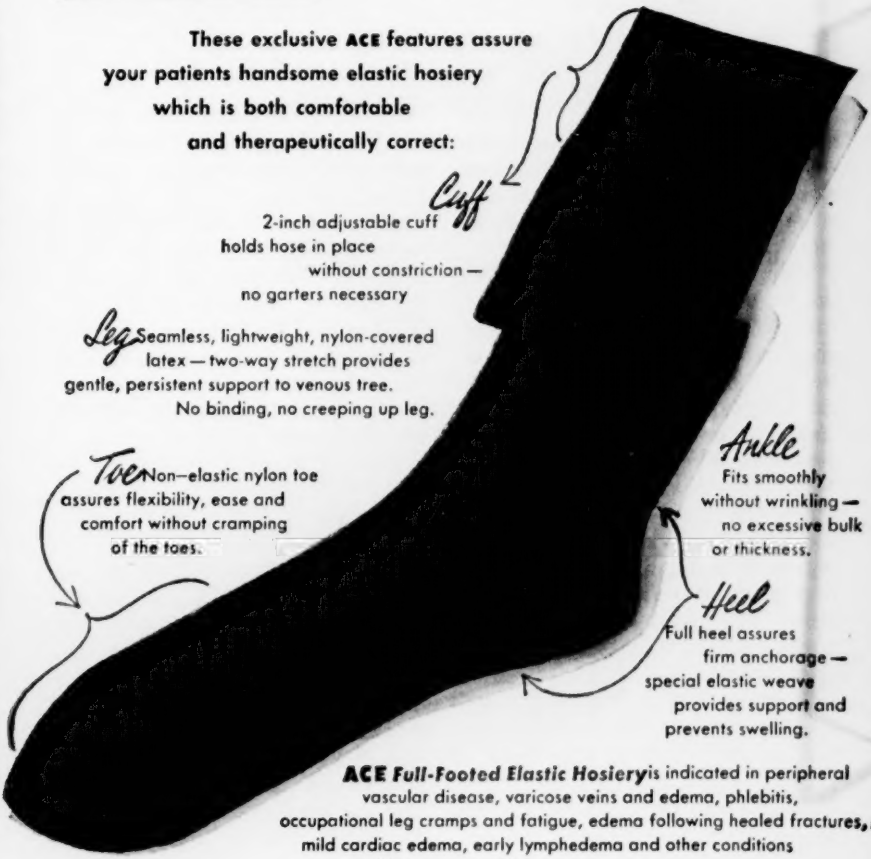

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height of the individual. The ideal length of bone in a below-knee stump is from 5 to 7 in. measured from the superior articular surface of the tibia. An individual 6 ft. tall should have a below-knee stump aproaching 7 in. long.

In general, the site is through the lowest completely muscular portion of the calf, before the muscles become tendinous. Longer leg stumps, which at the distal ends are composed of only tendons, are avascular and the skin does not stand the pressure of a prosthesis well. A stump which includes part of the lower third of the leg makes it impossible to contour the prosthesis to match the normal leg.

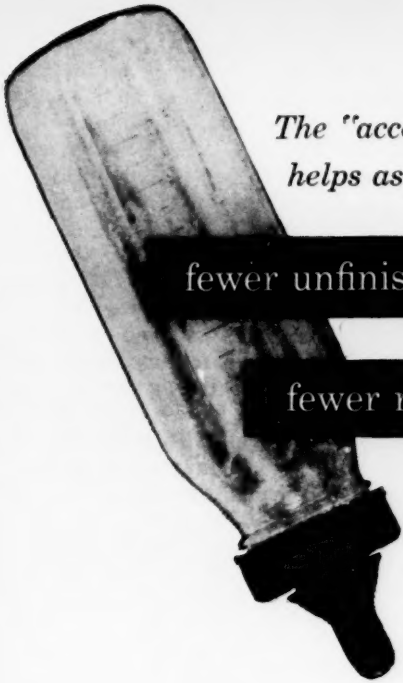
Although 5 to 7 in. is the ideal site for the below-knee amputation, stumps shorter than this are of great value. Any stump which projects as much as an inch below the hamstrings with the knee flexed may be of considerable help in motivating a prosthesis.

For an amputation through the *thigh*, the best site is the supracondylar area, the bone section being made at a point just below the beginning of the flare of the condyles. This presents a broad triangular rather than a tubular cross section of femur. This site results in a stump with a long bone lever, which is conical, has a broad base for weight bearing, and uses a prosthesis well. Any decrease in the length of the femur above the supracondylar area increases the difficulties in wearing a prosthesis. If higher amputation is necessary, as much of the femur as possible should be saved.

Disarticulation of the *hip* is an amputation which requires such a cumbersome prosthesis that most people prefer crutches. If the pathology will permit, a pertrochanteric amputation is preferable. The prosthesis is much less cumbersome and easier to wear than that for a disarticulated hip.

In *children*, before completion of bone growth, amputations may have to be done initially at unorthodox sites in order to preserve epiphyses and maintain the full potentialities of growth in length. To preserve the lower femoral epiphysis of a young child who requires an amputation, it may be advisable to amputate through the knee joint, or similarly in the lower leg through the malleoli of the tibia and fibula. This will make the procurement of a prosthesis difficult but, when growth is complete, reamputation at the ideal site will save valuable stump length.

Loss of a major portion of the upper extremity is a far more serious handicap than a major amputation in the lower extremity. The loss of function is not as well replaced by a prosthesis. Certain *arm* stumps use a prosthesis more satisfactorily than others. No arm stump above the level of the humeral insertion of the deltoid muscle handles a prosthesis satisfactorily. The ideal site for an amputation through the humerus and the length of bone that uses a prosthesis best is the level just above the flare of the condyles. This removes 5 to 6 cm. of bone above the articular surface of the humerus.



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1. Bruce, J. W., Hackett, L. J. and Bickel, J. E.: Feeding Premature Infants, J. Pediat. 35:201 (Aug.) 1949.

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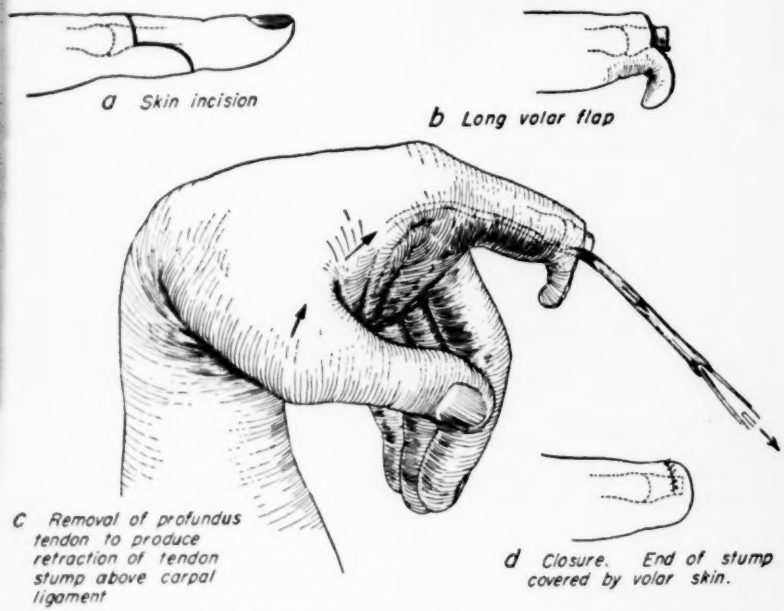
In the forearm, the ideal site of amputation is at the junction of the lower and middle third of the forearm. Every effort should be made to preserve the elbow. A prosthesis can be fitted to a stump as short as 1 to 2 in. below the elbow. Even though the radius has to be removed, a short forearm stump with only the ulna is worth preserving.

When trauma demands amputation *below the wrist* joint all possible tissue should be preserved. A stump with only carpal bones is of great functional value and, when possible, the carpus should always be saved. The greatest conservatism should be exercised before amputating any part of the *thumb*.

When amputation of a *finger* is necessary, an effort should be made to cover the end of the stump with volar skin (Fig. 8). However, unnecessary sacrifice of length should not be resorted to. When amputation through a finger proximal to the distal interphalangeal joint is necessary, the tendon of the flexor profundus muscle to that finger should be pulled out and cut short so that it will retract above the wrist and not become adherent and checkrein the flexion of the remaining fingers. This is accomplished by placing the wrist and finger in palmar flexion, pulling the tendon out with a hemostat, and allowing it to retract.


a Skin incision
b Long volar flap
c Removal of profundus tendon to produce retraction of tendon stump above carpal ligament
d Closure. End of stump covered by volar skin.

From Cole, W. H., Operative Technic in General Surgery. Courtesy of Appleton-Century-Crofts, Inc.

Fig. 8. Amputation of a finger

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Prepared for Modern Medicine

Acute Peripheral Nerve Injury

BARNES WOODHALL, M.D.*
Duke Hospital, Durham, N. C.

SOME controversy exists concerning proper management of acute peripheral nerve injury. The differences of opinion stem not from any fundamental issue but rather from contrasting approaches to the desirable end—the earliest nerve suture compatible with maximal anatomic reinnervation and functional restoration of the extremity.

The concept is widely held that primary, immediate, or emergency nerve suture represents the best means for attaining this end. Except in the most expert hands and with highly selected cases, immediate nerve repair exhibits shortcomings that cannot be overcome without detriment to the patient. The purpose of this survey is to present a dogmatic approach to the management of peripheral nerve injury based upon the principle of deferred or elective repair.

DIAGNOSIS

The first principle of management has to do with the diagnosis or recognition of the fact that a peripheral nerve has been injured. Evidence of such damage should be sought in all lacerating wounds of the extremities, in all fractures of long bones, and in all injuries in which the element of tissue stretch is obvious. Simple tests are available for both upper and lower extremities, even though the limb is in a cast or pressure dressing.

Loss of sensitivity to pinprick over the tip of the index finger indicates median nerve involvement; loss of sensitivity to pinprick over the little or fifth finger indicates ulnar nerve involvement. No constant sensory test is available for testing radial nerve function, but the gross motor loss of extension of the wrist, fingers, and thumb, termed "wrist drop," is easily recognized.

In the leg, the sensory defect in peroneal paralysis is variable. Loss of extension of the foot and toes is indicative of peroneal paralysis. Loss of extension of the big toe can be tested even though the extremity is firmly immobilized in a cast. Tibial nerve involvement is shown by the loss of flexion of the foot and toes and by sensory loss over the sole of the foot. Sensory loss may be the only evidence of tibial nerve injury with laceration in the lower third of the calf. Sciatic nerve injury is recognized by a combination of the above.

Complicated nerve injuries of the brachial and lumbosacral plexuses may be defined by evaluation of the separate peripheral nerve components. Characteristic hand postures may be noted at the time

(Continued on page 178)

*Professor of Neurosurgery, Duke Hospital and Medical School, Durham, N. C.

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REFERENCES: 1. Dey, T. J. et al.: Proc. Staff Meetings Mayo Clinic 21:497, 1946. 2. Haagland, R. J.: Am. Jl. Med., 9:272, 1950. 3. Smith, R. T.: J. Lancet, 70:192, 1950.

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of acute injury but are not as well defined as when muscle atrophy and shortening have occurred.

In all open or compound extremity injuries, the available evidence, if any, almost invariably suggests complete nerve division. Incomplete nerve lesions are recognized with difficulty. Intact fasciculi may be contused or stretched or may exhibit the phenomenon of physiologic block. They may recover promptly or exhibit axonal degeneration without disruption of tissue continuity. These phenomena occur particularly with the not uncommon small-caliber and low-velocity gunshot wounds of social strife. If the diagnosis of a partial nerve injury can be established at the time of the acute injury, further study of motor and sensory functions and the use of electrodiagnostic procedures will delineate the extent of dysfunction. In all injuries, a more discrete evaluation is possible by a period of postinjury study.

SELECTION OF CASES

The second principle of management concerns the selection of cases for immediate or deferred nerve repair. Scant justification exists for forcing the issue of primary repair and doing an emergency operation when an elective procedure with many obvious advantages may be employed within a few days after healing of the inciting wound. Criteria for primary repair are:

Wounds seen within the first three hours after injury in which infection has not been established

Wounds not grossly contaminated by highly infective material

Wounds in which the longitudinal extent of the nerve injury is such that ready suture of the prepared nerve ends may be possible

Wounds not complicated by severe tendon, bone, and vessel injury threatening the extremity as a whole

Wounds not complicated by other bodily injuries of immediate and grave prognosis.

In addition:

The surgeon must possess adequate anatomic background in peripheral nerve anatomy to prevent errors in tissue identification.

The patient must be prepared for a tedious and possibly lengthy operative procedure. Acute alcoholism, shock, marked apprehension, and the like interdict primary repair.

Certain technical features make primary suture difficult. The epineurium, which must be used to hold interrupted fine sutures, is delicate and tears easily. The longitudinal extent of injury, consisting of interfascicular hemorrhage and sheath ruptures, is difficult to define. The proper treatment of incomplete nerve division cannot be formulated at the time of emergency nerve repair.

With even moderate loss of nerve tissue, mobilization or transplantation procedures to overcome nerve gap may invite infection. Available studies show that the quality of axonal regeneration is not impaired if an adequate nerve suture is conducted within a three-month period after injury. These same studies portray a higher incidence of infection, suture line neuroma, and suture disruption in primary than in deferred repair.

TECHNIC

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1. Heimer, C. B., Grayzel, H. G., and Kramer, B.: Archives of Pediat. 68:382, 1951.
2. Behrman, H. T., Combes, F. C., Bobroff, A. and Leviticus, R.: Ind. Med. & Surg. 18:512, 1949.

repair. The first stage of deferred nerve repair has for a goal uneventful healing of the inciting wound. This may be accomplished by:

1] Thorough cleansing of the wound region with soap and water or with a bland detergent
2] Removal of foreign material from the wound
3] Thorough but conservative excision of devitalized structures
4] Repeated warm saline solution irrigation of the wound
5] Complete hemostasis
6] Closure of the skin wound with through-and-through fine black silk sutures without tension
7] Application of firm pressure dressing, leaving distal articulations of the extremity free for passive and active mobilization.

In this primary wound, peripheral nerve structures should not be sought by further tissue dissection even if clinical evidence of nerve injury has been recognized. Nerve ends, if easily identified, may be coapted with nonabsorbable sutures such as silk or tantalum. In such a coaptation, every effort should be made to prevent placing the sutures through normal nerve segments. Identifying sutures led to the surface of the wound are contraindicated but are all too often used.

Deferred or definitive nerve repair should be undertaken after primary wound healing or secondary wound closure has been accomplished. The time may vary from ten to thirty days after injury. The patient may then be prepared for an elective operation in a clean field under ideal circumstances. The surgeon is likewise prepared for a sometimes lengthy technical procedure that demands exact anatomic knowledge. The epineurium of the nerve segment has thickened sufficiently to hold sutures readily. The existing neuropathology, whether nerve division, as usually seen in the lacerating wounds of civilian life, or partial nerve division, is readily recognized.

After careful skin and fingernail preparation, the entire extremity is draped so that all residual muscle movement may be initiated by the patient and all articulations may be carried through a full range of motion. Skin incisions are planned along the longitudinal extent of the involved nerve segment and curved at all joint creases to prevent later scar contraction across the areas.

If any possibility of a partial nerve division exists, the proximal and distal nerve segments are isolated by local anesthesia at a point 2 to 3 cm. from the area of assumed injury. The proximal nerve segment may then be electrically stimulated for the presence of intact motor axons traversing the area of injury, and the distal nerve segment for intact sensory axons. In the majority of cases, the procedure may be conducted with use of general anesthesia.

After recognition of the type of nerve injury, these steps are in order:

1] Accurate identification of tissue. The suture of nerve to tendon is not uncommon in emergency nerve suture and cannot be recognized until many months afterward, when the failure of neural regeneration becomes obvious.

2] Complete removal of pathologic nerve ends to normal appearing fasciculi. Instruments have been devised for this purpose. Digital

pressure by warm saline packs and use of a fresh scalpel usually suffice.

3] Accurate apposition of nerve ends with prevention of rotation of nerve segments. Before resection of the pathologic nerve ends, the geographic location of the nerve segments to one another may be marked by single identifying fine black silk sutures placed temporarily through the epineurium.

4] Use of interrupted epineural sutures of fine nonabsorbable material, preferably ophthalmic silk or 0.003 tantalum.

5] Completion of suture without tension. In nerve wounds with considerable, 3 cm. or more, loss of nerve substance, suture line tension must be obviated by joint posturing and by nerve segment mobilization and transplantation procedures.

6] Meticulous care in handling of neural tissue. In particular, nerve segments must not be compressed by retraction or stretch during presuture mobilization.

7] Placement of single metallic epineural sutures 1 cm. from the suture line in distal and proximal nerve segments for postoperative roentgen check of possible suture line disruption. The majority of such suture line disruptions occur shortly after operation.

8] Protective casting of extremity, allowing adequate mobilization of metacarpophalangeal and phalangeal articulations, for at least four weeks.

PRESERVATION OF MECHANISM

The fourth principle of management has to do with preservation of the effector mechanism during the prolonged period of reinnervation of muscle. This may be carried out by:

- A gradual extension of flexed joints through physiotherapy and passive movements beginning when the cast is removed.
- Galvanic stimulation and active massage of paralyzed muscles. Very often the patient can be educated by physiotherapists in self-care of denervated musculature.
- Intermittent splinting of paralyzed muscles in a position of functional relaxation. This is particularly important in two specific nerve injuries, those of the radial and peroneal nerves in which wrist and foot drop must be corrected.

REHABILITATION

The last principle of management pertains to the care of acute peripheral nerve injury which may be classified as irreparable because of extensive loss of peripheral nerve tissue. Such patients should be referred for orthopedic rehabilitation as soon as the irreparable nature of the wound is known.

Orthopedic rehabilitation is particularly important with high wounds of peripheral nerve tissue, where regeneration may not suffice to give adequate functional restoration to the extremity, and with traction paralysis of peripheral nerve or brachial plexus in which surgical intervention is not indicated. The potential value of autogenous nerve grafts in irreparable peripheral nerve wounds is recognized; their use requires a highly specialized experience.

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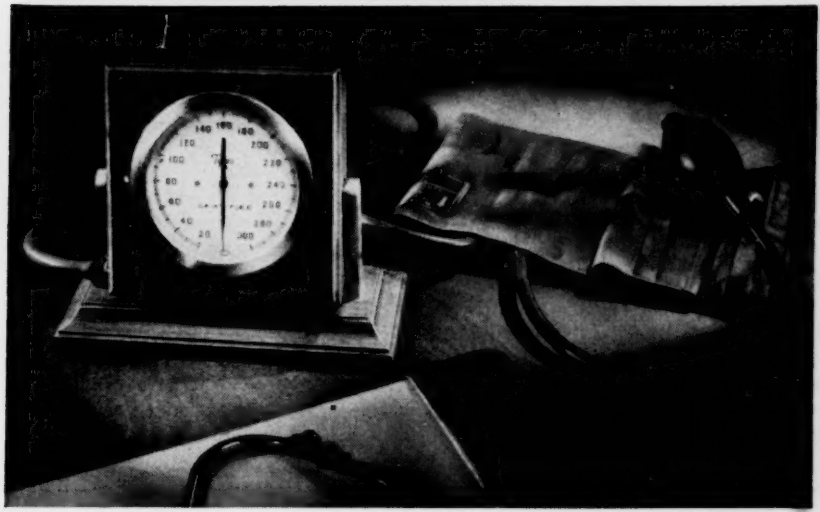

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Injuries to Large Blood Vessels

HARRIS B. SHUMACKER, JR., M.D.*
Indiana University, Indianapolis

INJURIES to large blood vessels must be treated promptly and adequately if the desired objectives are to be achieved—saving the patient's life and his injured limb and maintaining or restoring as nearly normal circulation as is possible. Delay in stopping the bleeding and in replacing blood lost jeopardizes the patient's chance of recovery. Treatment of the ischemic limb takes precedence over treatment of any associated injury which does not threaten life itself. Delay may result in gangrene and loss of limb.

The first problems to be dealt with are bringing about cessation of hemorrhage and replacement of blood loss.

Occasionally, bleeding may be stopped by compressing digitally the proximal artery against some bony part. This is an excellent method but can never be used for long periods and so is not applicable unless definitive surgery can be undertaken promptly. Sometimes, especially in bleeding from veins or small arteries, hemorrhage may cease with prolonged manual pressure over the wound or the use of a tight compression bandage.

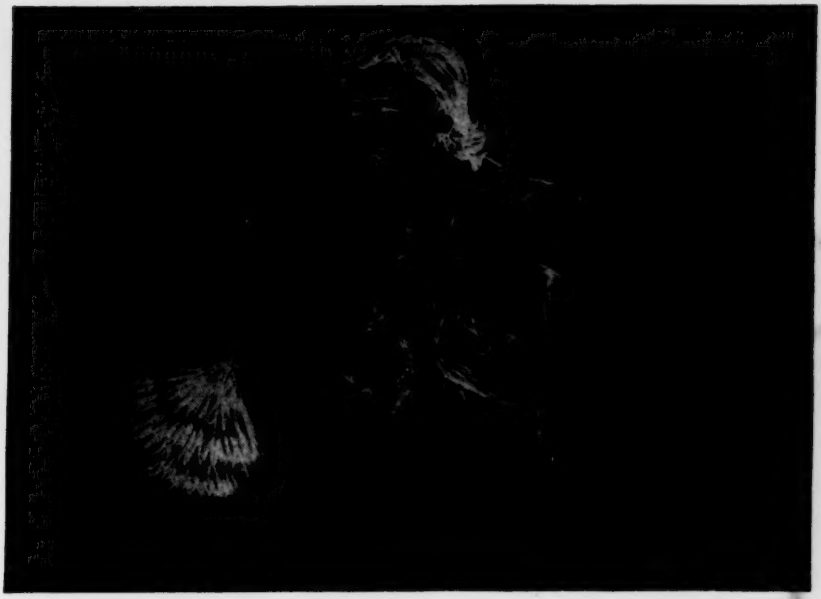
At times, packing the wound with gauze, or better still a hemostatic absorbable material, is effective. The patient should be watched carefully, however, for secondary hemorrhage and, when the gauze pack is removed, one should be prepared for surgical exploration.

Direct clamping of the bleeding vessel is sometimes an effective method of control and is particularly applicable when the injured vessel is readily visualized and one is confident it is not a main stem artery. Clamping of such an important artery may damage it irreparably so that surgical repair of an incomplete laceration is precluded. Care must be exercised to avoid injury to the neighboring structures such as nerves. Since hemorrhage may recur with release of the clamp, preparation should be made for immediate operation.

Use of a tourniquet for control of bleeding should be resorted to only if more suitable methods cannot be effectively employed. A tourniquet which is sufficiently tight to stop arterial bleeding necessarily renders the limb ischemic. Hence a tourniquet should not be left on for long periods. If definitive treatment must be delayed, the tourniquet should be released and reapplied at frequent intervals, preferably at least every hour. During the period of release, bleeding must be prevented by proximal compression of the artery or direct pressure over the wound.

If an amputation will apparently

*Professor of Surgery and Surgeon-in-Chief, Indiana University Medical Center, Indianapolis.



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The prophylactic effectiveness of Peritrate in angina is thoroughly documented.[1-4] Attacks are virtually eliminated in certain cases.[1] In others, they occur less frequently,[1-3] or are less severe,[1-2] nitroglycerin dependence is reduced[1,2] and exercise tolerance increased.[1,3,4]

Effective in 4 out of 5 patients. In one study, 78.4% obtained reduction in the number of attacks.[1] "A high percentage of beneficial results"—fewer attacks in 80% of patients—was obtained in another series.[2] Attacks not prevented were "less intense and of shorter duration."[1]

Results duplicated in private practice. More and more physicians are finding that, with adherence to a regular schedule of 1-2 tablets 3 to 4 times daily, many patients are free from attacks or have fewer, less severe attacks.

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Peritrate is virtually nontoxic. Mild, transitory side effects occur rarely and are easily controlled. Tolerance has not developed in patients studied.

Available: 10 mg. tablets in bottles of 100 and 500.

1. Angiology 3:1 (Feb.) 1952. 2. New York State J. Med. 52:2012-2014 (Aug. 15) 1952. 3. Angiology 3:16 (Feb.) 1952. 4. Angiology 3:30 (Feb.) 1952.

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be necessary, the tourniquet should be placed as close to the site of injury as possible so that any resulting damage will be in the portion amputated. The tourniquet should be placed more proximally if there is likelihood of saving the limb, so that the operation can be carried out distal to it. The best tourniquets are broad and elastic, such as an Esmarch bandage or a sphygmomanometer cuff. Rubber tubing is effective; if necessary, rope or cloth may be used.

If possible, shock should be prevented. When present, shock should be treated aggressively without delay. Administration of whole blood is by far the most ideal method of replacing lost blood. One should give more, not less, than the quantity estimated to have been lost. Plasma is the best blood substitute. When neither blood nor plasma is available, the intravenous administration of physiologic electrolyte solutions may help maintain circulation until blood can be secured.

Exclusion of circulation from the normal extremities by Esmarch bandages should be resorted to only when shock is present, or rapidly impending, and no fluid replacement is possible. This measure may be lifesaving under such circumstances. Circulatory exclusion from the extremities must not be maintained for long, and blood or plasma must be given in adequate amounts before the release. The shocked patient should be placed in the Trendelenburg position and overheating ought to be avoided. Pain should be eliminated by proper local care of the injured limb and by morphine as required. During circulatory collapse, morphine is best given intravenously.

The necessity for immediate direct operative treatment depends upon a number of circumstances—the vessel involved, the nature of the injury, the continuance of bleeding, the presence of associated injury to the limb, and the presence of ischemia. Cessation of bleeding is more likely when small veins and arteries rather than large vessels are injured or when the wound is small so that escape of blood is difficult. Other factors favoring cessation of bleeding are bad contusion of neighboring tissues or severe contusion of the injured vessel itself, complete division rather than partial laceration of the vessel, and concomitant laceration of an adjacent vein permitting passage of arterial blood lost into the low pressure venous system. Factors which favor continued bleeding are injuries of large vessels, especially of arteries, clean wounds without contusion, large open injuries which provide an easy escape of blood to the exterior, and incomplete lacerations of vessels.

Although each case must be considered individually, immediate operation is generally not required when bleeding ceases spontaneously, when the limb is not ischemic, and when any hematoma present is not compressing nerves. Immediate operation should be performed when bleeding continues, when the limb is ischemic, and if a hematoma causes damage by pressure.

Any contused injury or a wound

(Continued on page 190)

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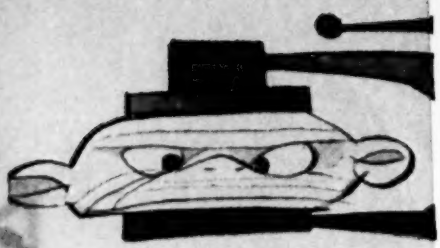
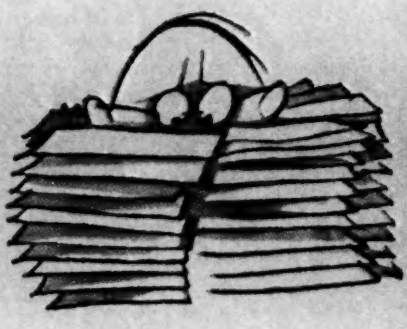


pressure

When

diet



work

worry

emotional disturbances

pressure, diet, work, worry,

emotional disturbances, visceroneurosis

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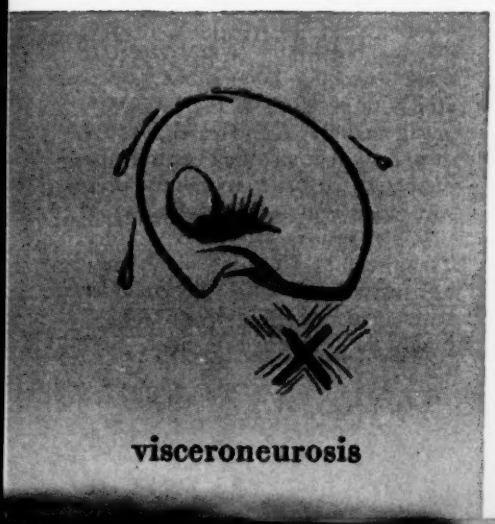

visceroneurosis

Merrell
1828

New York • CINCINNATI • Toronto

1. Hock, C. W.: J. Med. Assn. Ga. 40:22, 1951 • 2. Hufford, A. R.: J. Mich. St. Med. Soc. 49:1308, 1950 • 3. Chamberlin, D. T.: Gastroenterology 17:224, 1951 • 4. Pakula, S. F.: Postgrad. Med. 11:123, 1952—*Trade-mark "Bentyl" Hydrochloride*

containing large dirty foreign bodies should be treated by prompt and adequate debridement. Clean wounds without foreign bodies or with clean small foreign bodies, such as small metal fragments, do not require exploration provided no other indication exists for immediate operation, such as ischemia not relieved by appropriate supportive measures. If the injury has, however, interrupted a main stem artery, a choice is afforded. Operation is advisable if a surgeon trained in vascular reparative technic is available, for the chance may be good of restoring arterial continuity and avoiding subsequent circulatory disorders. The risk of failure or even of increased damage is too great, however, to warrant attempts at repair under such circumstances by one unfamiliar with vascular suture technics. The same holds true even when a large hematoma is present not causing compression symptoms. Immediate exploration and repair of the artery may restore perfect circulation and prevent a saccular aneurysm. Without trained personnel, however, the limb is better left alone and the aneurysm repaired subsequently.

In some circumstances it is better to operate with a tourniquet, in others it is not. Obviously, injury in certain areas precludes use of a tourniquet as, for example, wounds of the subclavian or iliac arteries. In all circumstances, however, it is essential that the vessel be so controlled as to obviate bleeding.

If a tourniquet is not employed, the wounded vessel must be isolated proximally and distally before the damaged portion is attacked. If ligation is carried out, the vessel should be divided and the ends ligated and transfixed with nonabsorbable suture material rather than by ligation in continuity. The vessel should be freed carefully from surrounding tissues, not ligated en masse. If the injured artery is to be repaired, the damaged area should be clean. Gross adventitia ought to be stripped away.

Only the finest needles and nonabsorbable suture material should be used. Swedged-on needles of 5 or 6 zero silk are preferable. During repair, the intimal surface of the vessel should be kept moist with sterile physiologic saline solution, heparin solution, or mineral oil. Repair is preferably accomplished with interrupted everting mattress sutures, though the continuous Carrel type of over-and-over suture is satisfactory. Whether lateral arteriorrhaphy, end-to-end suture, or interpolation of a free venous autograft is done depends on the nature and extent of arterial injury.

Arteriovenous fistulas are generally best left alone and treated surgically at a later date, after the adequacy of the collateral circulation has been established by proper tests. Pulsating hematomas associated with ischemia of the extremity, unrelieved by adequate supportive measures, should be treated immediately, in order to relieve pressure upon collateral vessels and, if possible, restore arterial continuity. Treatment of pulsating hematomas not associated with ischemia or with evidence of interruption of blood flow through a main stem

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1. Bradley, J. E., et al.: J. Pediat. 38:41, 1951; idem: Amer. Acad. Pediat., meeting Oct. 16, 1951.

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artery should be deferred; operation should be carried out only after tests have revealed that the collateral circulation about the injured artery is satisfactory. When a pulsating hematoma is encountered associated with interruption of blood flow through an important artery without resultant ischemia, the decision whether to attempt immediate repair of the artery should depend upon the presence of personnel trained in vascular repair.

Management of the ischemic limb is of primary importance. All injury to the foot or hand must be avoided. The bedclothes should not be allowed to press upon it. Local heat should never be used and local refrigeration is used only in an effort to decrease the chances of infection of the stump when amputation is to be done.

The hand or foot should be kept below the level of the heart in order to favor blood flow. If edema develops, the position must be determined so as to leave the limb dependent and, at the same time, avoid significant swelling. Everything should be done to promote collateral blood flow.

This is best accomplished by regional interruption of the sympathetic supply, preferably continuously, at least until the danger of ischemia is gone. Either a small plastic tubing may be introduced paravertebrally for intermittent administration of procaine or the chain may be chemically blocked by alcoholic injection. In some instances operative sympathectomy may be advisable. If none of these methods seems appropriate, intermittent injections of procaine may be of aid. Autonomic blocking agents should not be used; they tend to increase circulation to the normal extremities and produce little or no improvement in the circulation of the ischemic limb.

It would be desirable to use anticoagulants in all cases associated with ischemia and in all in which reparative vascular surgery has been accomplished. Unfortunately in cases of trauma it is often impossible to obtain the complete hemostasis essential for their safe use. Anticoagulants should not be used unless hemostasis is complete.

Interruption of the blood flow through important arteries as a result of trauma does not necessarily indicate arterial division. The interruption may be the consequence of arterial thrombosis or of segmental arterial spasm. In both conditions every means for increasing the effectiveness of the collateral circulation should be used. If hemostasis is complete, anticoagulants are also advisable to prevent thrombosis or the spread of thrombosis. In cases of thrombosis sharply limited to a short segment, thrombectomy and adequate anticoagulant therapy or excision of the thrombosed segment with interposition of a venous graft may be effective.

Segmental arterial spasm may disappear with sympathetic block or spinal or caudal anesthesia. If a spasm persists, the problem is difficult. Stripping the vessel of adventitia, bathing it in procaine solution, and injecting procaine and vasodilator solutions into the proximal artery may help.

Prepared for Modern Medicine

Treatment of Burns

T. G. BLOCKER, JR., M.D.*
University of Texas, Galveston

AT the beginning of the century standard textbooks on surgery and articles in medical journals advocated for the treatment of burns such local remedies as carron oil, carbolic acid, bichloride of mercury, lead carbonate, zinc oxide, gum arabic, lard, collodion and castor oil, icthyol, silver nitrate, picric acid, concoction of blueberries, and molasses-soaked blotting paper.

In 1906 the *New York Medical Journal* offered a prize of $25 for the best essay on the subject, "How Do You Treat Burns?" If such a contest were sponsored today, probably the same list of agents, with the exception of the blueberries and blotting paper, would be recommended as "ideal," augmented by 500 others, including tannic acid, gentian violet, Foille, Unguentine, chlorophyll, Furacin, Dakin's solution, normal saline, Vaseline, Zephiran, casein, sulfonamides, penicillin, boric acid, aluminum foil, plaster casts, and open air.

Although too much emphasis is still placed on local treatment and too little attention is given to primary shock therapy and skin grafting as early as possible in full-thickness burns, great advances have been made in general therapy.

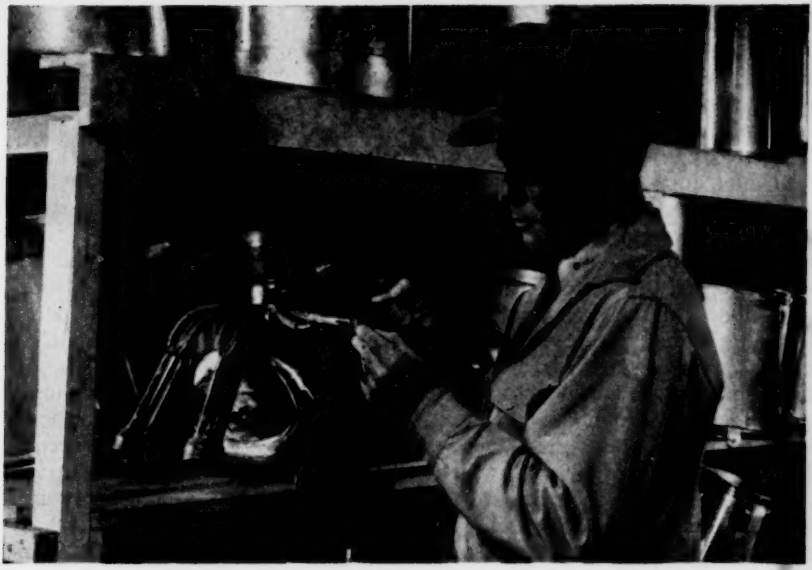
As in a case of diabetic coma, the most important principle in early treatment in a burn case is to remain by the bedside until the initial shock period is over, gauging requisite therapy from hour to hour by the patient's response as well as by more objective data.

Burns which require supportive treatment are, in general, those covering more than 10 to 15% of the body surface or those accompanied by signs of shock or which give indication from the depth of involvement that skin grafting may be necessary. Lesions of the hands are particularly important since, on the dorsum and over the palmar surface of the fingers, so little protective subcutaneous tissue is present and so much is at stake from an economic standpoint.

Minor burns may be successfully treated by any pharmaceutical preparation or home remedy that does not contain a harmful agent, but they heal equally as well and often more quickly without any local treatment or with a simple protective dressing. Particularly in small children, gratifying results are obtained without the so-called burn remedies.

Alterations which occur in response to severe burn trauma are related to the stress phenomenon, to local physicochemical pathology, and to loss of function of the

*Department of Plastic and Maxillofacial Surgery, University of Texas Medical Branch, Galveston.



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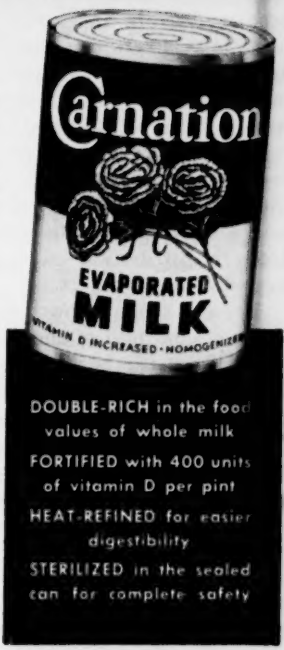

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skin as an organ. The changes depend upon depth and extent of involvement and in large measure upon the type of burn, intensity of heat, and duration of exposure.

The components of clinical shock are well known: increased capillary permeability, low circulating blood volume, hemoconcentration, low blood pressure, tissue anoxia, low temperature, depression of the central nervous system, protein catabolism, and endocrine chain reactions. Burn shock is characterized by three additional factors: [1] external loss of plasma, which disturbs both fluid and protein balance, [2] decrease in circulating red cells, both relative and absolute, from actual destruction in the burn area and from increased fragility of cells as a result of thermal damage, and [3] the phenomenon of burn edema, which depletes uninjured tissues of fluid and is accompanied by radical alterations in sodium : potassium distribution. Sodium is trapped in the edema fluid and a high blood potassium results from redistribution of electrolytes and destroyed red cells.

For the relief of burn shock, the replacement fluid of choice is whole blood from the beginning. This restores the circulating blood volume and provides sufficient red cells to overcome anoxia of the tissues. Extreme hemoconcentration on laboratory examination is not a contraindication to transfusion therapy, since the condition results from greater relative loss of plasma and masks anemia as severe as that produced by major hemorrhage. The quantity of blood required should be dependent upon the degree of shock and the patient's response to therapy. Most adult patients with burns of more than 20% of the body surface require from 1 to 3 liters in the first twelve to twenty-four hours.

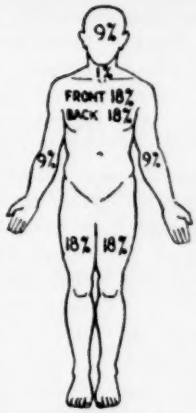
Since administration of blood is necessarily delayed by typing and cross-matching procedures and perhaps by securing donors, treatment of shock should be initiated with plasma, dextran, or other colloids. Normal saline or dextrose in saline may be used temporarily to prevent collapse of available peripheral veins which are often at a premium when burns involve the extremities. When a cut-down is necessary, the procedure should be done with dispatch before the patient receives any other treatment except sedation. A useful formula for transfusion therapy in the first twenty-four hours is: 1 cc. per kilogram of body weight for each 1% involvement of body surface (not to exceed 4,000 cc.). In the second twenty-four hours, half this amount should be given.

In calculating the extent of burns, a modification by Tennison and Pulaski of Berkow's guide may be employed, using multiples and divisions of 9% (see illustration). The tendency is to overestimate.

Sodium should be supplied during the edema phase. Sodium chloride by vein, however, lowers the osmotic pressure of the blood and secondarily increases the amount of burn edema. In large amounts, sodium chloride may embarrass the pulmonary circulation.

We have found the most satis-

factory method of administration to be the oral route with a modified Haldane solution (3.5 gm. of sodium chloride and 1.5 gm. of sodium bicarbonate per liter of distilled water). This replaces drinking water for the first forty-eight hours and prevents water intoxication, which used to be seen so commonly with irritability, delirium, nausea, and uncontrollable vomiting.



Rule of Nine

In the presence of acidosis or initial intolerance to the hypotonic saline, we employ an intravenous solution of 5% glucose, to which has been added an ampule of Ringer's lactate, and then begin oral fluids. Orange and other fruit juices high in potassium are contraindicated during the early period, as is cracked ice, which is too low in sodium content.

In an occasional case, oral fluid therapy cannot be employed because of the severity of shock or vomiting induced by water given before hospital admission. In these instances intravenous electrolyte solutions are given to supplement colloid therapy and to replace normal urinary and insensible water loss. We employ the following formula for the first twenty-four hours as a guide, using half the amounts recommended by Evans: 0.5 cc. of normal saline per kilogram for each 1% involvement plus 2,000 cc. of 5% glucose in distilled water. Care must be taken to avoid giving a larger amount of glucose in water and causing water intoxication. To prevent transfusion reaction, blood should not be given through tubing which has carried glucose.

As an index of the efficacy of fluid therapy in severely burned patients, we employ a retention catheter and measure the volume of urinary output, which can be maintained at 25 cc. or more per hour during the critical period except in presence of acute renal insufficiency.

On the third or fourth day, as patients enter the subacute phase, diuresis begins, though not in as spectacular a fashion as before the use of oral electrolyte therapy. If the patient has not been receiving maintenance fluids by vein, little danger exists of pulmonary edema.

Oral alkaline solutions are discontinued, and with recovery of the gastrointestinal tract from shock, intensive feeding may be begun to meet the increased needs for tissue repair, red cell regeneration, liver protection, and the requirements of the accelerated metabolism. Forced feeding by continuous intragastric drip eliminates the factor of appetite and insures a high-caloric, high-nitrogen intake with 200 to 500 gm. of protein in addition to what is taken from the house diet.

We use a whole-protein formula of milk, Dextri-Maltose, and Protolysate or other protein concentrate, such as Stuart's amino acids and Somagen, to which may be added the supplementary vitamins, and employ a small intranasal plas-

tic catheter. If Lipomul, rather than cream, is used for supplying necessary calories from fat, the feeding may be satisfactorily autoclaved without loss of homogenicity. We have devised a special pump to aid in feeding, but gravity apparatus may be used if only small amounts are exposed to room temperature, to prevent decomposition, and if water is occasionally inserted by syringe to prevent clogging.

Additional transfusions may be required during the subacute phase because of continued loss of red cells in dressings or at the time of debridement of the burn slough. Loss of sodium, potassium, and calcium through granulations must be compensated for by increased intake in the diet or special therapy.

Circulatory derangements are frequent in burn patients and occur often as the result of inadequate amounts of blood during the shock period. A definite tendency exists toward thrombotic phenomena. When the legs are not involved, early ambulation is encouraged and is practicable.

Loss of function of the skin as an organ affects chiefly temperature regulation, water and chloride excretion, and protection against trauma and invasion by pathogenic organisms.

Every effort should be made to combat infection, which is the commonest complication of deep burns and the most difficult to control if standard dressings are employed. These encourage bacterial growth by providing warmth and retaining moisture.

Administration of T.A.T. or booster doses of toxoid should never be omitted. ACTH is at the present time felt to be contraindicated in severe burns because the hormone has been associated with fulminating spread of infection in a number of instances. We have employed penicillin routinely for systemic administration, but other drugs should be used as indicated for the control of organisms resistant to penicillin or more sensitive to the newer antibiotics.

With any dressing technic, strict sterile precautions must be maintained. When the exposure method can be utilized, local infection may be controlled during the dry coagulum period without rigid adherence to aseptic principles, since pathogenic organisms on the slough surface are rendered innocuous by local absence of moisture and heat for proliferation.

An integral part of the program is maintenance of high morale by constant nursing attention, daily visits from as many staff members as possible, avoidance of pain in dressings by use of anesthesia to the point of analgesia, diversion therapy, and abundant protein.

Initial treatment of a severely burned patient is summarized in Table 1. Modifications are made according to the type of local technic indicated.

Even with adequate therapy, death may occur during the first twenty-four to forty-eight hours from respiratory tract injury, in elderly individuals, and with burns above the critical 60 to 70% level at any age. Once the shock is con-

(Continued on page 202)

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Dosage: 1 tablet ½ hour before meals, three times daily, for the vagotonic type. Increase this dose, if necessary, to achieve the desired clinical results. ½ tablet ½ hour before meals, three times daily, for one week for the sympathicotonic type. If no signs of intolerance develop, increase to 1 tablet. Supplied in bottles of 100 and 1000 scored tablets.

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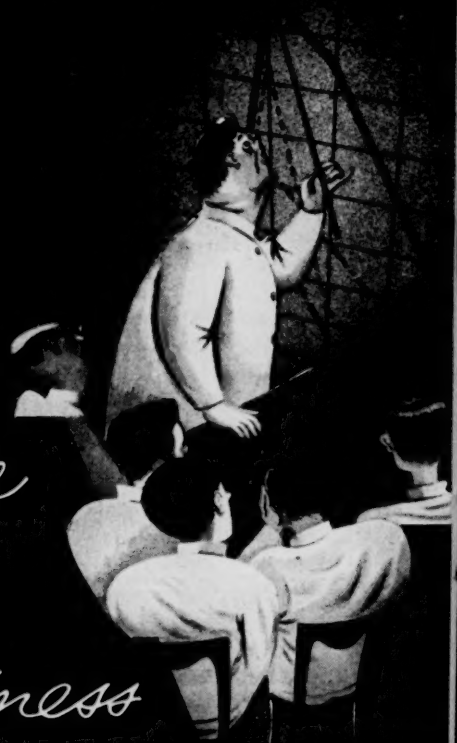

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Chart shows increase in biliary secretion after injection of sodium dehydrocholate, as compared to various bile salts.

Cholan

trolled, the most crucial stage occurs at about the ninth to twelfth day.

At this time patients die whom we could not anticipate saving because of the extent of full-thickness skin loss but who survived the early period as a result of vigorous supportive treatment. Other patients with 30% or more burns who are progressing satisfactorily as far as can be determined suddenly at this point enter a state of "burn decompensation" characterized by clinical exhaustion, bizarre alterations in fluid and electrolyte status, and decreased resistance to infection. Sudden deaths may occur among this group in spite of our best efforts.

Operative procedures without appreciable skin restoration are poorly tolerated. For this reason, patients scheduled for grafting should have ample blood and other fluids at hand and the most skilled anesthesia service available. Skin should be applied in maximum amounts with a team of workers and as quickly as possible in an endeavor to counterbalance the additional stress imposed by surgery.

In case of severe burn, local treatment should never be initiated until shock measures have been employed and other serious injuries have received attention. The only exception to this rule is that involved extremities should be elevated as soon as possible to eliminate the gravity factor in edema formation. Choice of the type of local therapy in any particular instance depends upon severity of the burn with respect to depth and extent, regional involvement, availability of auxiliary personnel, and the operator's preference.

Though pressure dressings have

(Continued on page 206)

TABLE 1. ADMISSION ORDERS

1. Emergency sedation if required.
2. Type and cross-match; draw blood for complete blood count and hematocrit; repeat in twelve hours.
3. Oxygen if required; inspect for respiratory tract burns.
4. Intravenous colloid therapy (dextran or plasma) if blood not immediately available; intravenous normal saline meanwhile.
5. Whole blood according to colloid formula: 1 cc. per kilogram of body weight per 1% of involvement for first twenty-four hours (not over 4,000 cc.). Use Rule of Nine for estimate. Include colloids previously given. Give half this amount of blood in second twenty-four hours.
6. Hypotonic saline–sodium bicarbonate solution orally as tolerated by patient (no cracked ice, tap water, milk, fruit juice, and so on).
7. No food by mouth for twenty-four hours except by special order.
8. Temperature, pulse, respiration, and blood pressure every two hours for eight hours; then every four hours.
9. Skin test for T.A.T. and administer 1,500 units or if patient has had tetanus toxoid, give 1-cc. booster dose.
10. Insert retention catheter and record hourly volume of urine (25 cc. minimum satisfactory output) for twenty-four hours, then by eight-hour periods; stat urinalysis; repeat in twelve hours.
11. Record intake and output of fluids on proper form; record emesis volume. Record intake separately for forced feeding.
12. Routine bacteriology culture.
13. Penicillin 300,000 units every twenty-four hours.
14. If oral fluids are not tolerated because of vomiting, give intravenous fluids as follows for first twenty-four hours:
    a] Saline and/or sodium lactate, 0.5 cc. per kilogram per 1% involvement
    b] 5% glucose in distilled water, 2,000 cc.
15. Photograph patient.
16. Record history and physical examination for medicolegal records.
17. Local treatment. See Tables 2-4.

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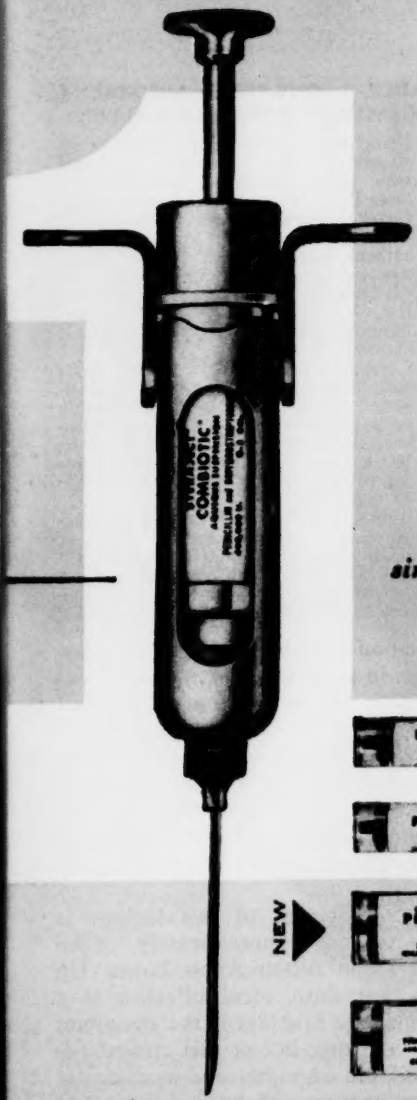

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been the generally accepted procedure for about ten years (Table 2), two alternate technics have been advanced recently. The first is a ready-made occlusive dressing pad of layered gauze with a water-repellent backing devised by Evans and Allen originally for civilian defense purposes (Table 3). The pad is not commercially procurable as yet but may be duplicated for hospital use.

The second innovation in local therapy is the exposure or open-air method (Table 4) which appears at first glance to be a most radical procedure but is in reality a revival with certain modifications of a technic developed and popularized in this country in the early 1900's. In our experience with over 250 cases we have found the exposure method superior to occlusive dressings in acute cases when *proper* exposure can be obtained; use is not contraindicated after preliminary dressings have been applied for a period of several days but the measure cannot be employed after the burn has been converted to an open wound by the loss of overlying injured tissue.

TABLE 2. PRESSURE DRESSINGS

1. Using strict aseptic precautions for all attending personnel, remove gross dirt with liquid detergent solution and flush burn surfaces with warm saline.
2. Cover burned surfaces longitudinally with a single layer of dry, sterile, fine-mesh gauze, rayon, or nylon cut in large pieces.
3. Apply longitudinally standard gauze burn rolls or a bulky layer of fluff gauze and mechanics' waste, using elastic bandage to hold layer in place and provide firm, even pressure. Avoid tourniquet effect and too much pressure over chest. Place burned hands in position of function; keep knee and elbow joints in extension. Elevate involved extremities.
4. Change dressings in operating room with anesthesia to the point of analgesia. Remove bandages with large quantities of saline and reapply. Unless dressings become contaminated or evidence of infection is seen, leave first dressing in place one to two weeks.
5. Prepare for grafting of third-degree burns by excision of necrotic material on burn surface and application of wet dressings, Furacin gauze, or other type of grease gauze.

TABLE 3. ONE-PIECE ABSORBENT DRESSINGS (EVANS AND ALLEN)

1. Using strict aseptic precautions for all attending personnel, remove gross dirt with liquid detergent solution and flush burn surfaces with warm saline.
2. Cover burned surfaces longitudinally with the ready-made one-piece absorbent burn dressing,* holding dressing in place with firm gauze roll bandage. Place burned hands in position of function; keep knee and elbow joints in extension. Elevate involved extremities.
3. Change dressings in operating room with anesthesia to the point of analgesia. Remove bandages and reapply or prepare for grafting as with pressure dressings. First dressing may be left in place one to two weeks according to the depth of burn and evidence of infection.

*Composed of an inner layer of dry fine-mesh gauze, an intermediate layer of 1 in. of absorbent cotton and many layers of absorbent cellulose, and outer 6 layers of water-repellent cellulose (non-woven cotton fabric chemically treated).

Employment of this technic is limited to approximately three weeks in full-thickness burns. Up to that time, local infection is a negligible problem if the coagulum is kept dry; but at this critical period, the edges become succulent at the juncture with normal tissue and suppurative invasion beneath the slough will occur rapidly unless excised mechanically in preparation for skin grafting.

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those involving only one side of the body or the anterior or posterior surface only of the trunk. Dressings are imperative from the beginning of treatment for chronic burns with open granulations and for extensive encircling involvement of the trunk.

TABLE 4. EXPOSURE THERAPY

1. Remove gross dirt with liquid detergent solution and flush burn surfaces with warm saline.
2. Place patient on sterile sheets with burned areas completely exposed to the air at room temperature, elevating involved extremities.
3. If bedclothing is necessary, suspend over a wire frame or on gauze strips, making sure that sheets do not touch burns. Protect patient from drafts with screens.
4. Extensively burned hands should be put up in position of function for forty-eight hours in pressure dressings and early grafting should be attempted. Keep knee and elbow joints in extension.
5. As soon as coagulum dries (two to four days), patient may become ambulatory for bathroom privileges and meals unless lower extremities have been burned.
6. Inspect coagulum daily for cracks or areas of moisture at junction with healthy skin or in flexion creases. Excise these sources of infection with sterile scissors and cover with a single-layer gauze dressing cut to fit and moistened with saline for adherence.
7. Loose crusts over healed second-degree burns may be allowed to fall off spontaneously or be picked off with forceps (eight to sixteen days).
8. The coagulum over third-degree burns will be adherent and contracted by the second week. This is the optimum time for mechanical excision from the underlying subcutaneous tissue and immediate or delayed grafting after one or two days of wet dressings, Furacin gauze, or other type of grease gauze.
9. Do not expose granulation tissue or raw surface at any time after removal of burn slough.
10. Do not continue exposure therapy beyond the third week in full-thickness burns even with intact coagulum.

tempted. Keep knee and elbow joints in extension.

Deep burns of the hands should be put up in the position of function with a bulky dressing for at least forty-eight hours to encourage maintenance of this position when the dressing is removed.

Whether covering bandages are employed or not, the present tendency in teaching hospitals is to frown upon any local medication in burns, even Vaseline gauze, during the acute stages. Furacin-impregnated gauze or wet dressings of saline, plain or incorporated with a specific antibiotic, are employed on open burn wounds and in preparation for grafting, which should be scheduled as a rule between two and three weeks after injury if the patient's general condition is satisfactory. As much raw area as possible should be covered at the first operative procedure, if several are required.

When more than 50% of the body surface is involved, homografts may be lifesaving at times but use delays by many weeks the final healing time since the grafts must be replaced ultimately with the patient's own skin except in the case of identical twins. Metabolic equilibrium cannot be reestablished until the continuity of the skin is restored. For this reason, cosmetic considerations should be sacrificed for coverage, using sheets or strips of skin cut from large dermatome or free-hand grafts. Deep pinch grafts are absolutely contraindicated. Partial-thickness transplants will survive as readily without rendering the donor areas unfit as further source of skin for coverage in extensive burns.

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REFERENCES 1. H[illegible] 2. [illegible] *The Diagnosis and Treatment of Gastric Pathology* by Edward L. Hardt, M.D.

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After the Acute Emergency

ALEXANDER P. AITKEN, M.D.*
Tufts College, Boston

GREAT advances have been made in recent years in the treatment of acute trauma. This progress has been due in part to the stress placed on adequate first aid and competent transportation of the injured.

The longest strides, however, have come through new technics in the surgical handling of the various traumatic lesions, aided immeasurably by the discovery of the antibiotic drugs.

But, with all these advances, have our end results improved appreciably? Doubt is cast upon this point when one realizes that of 1,952,000 people injured in industry in the United States in 1950, about 84,000 have some degree of permanent disability. Further estimates indicate that there are in this country today some 2,000,000 persons disabled as the result of injury or disease who could be rehabilitated and placed in gainful employment. To be sure, the nature of some injuries precludes anything but partial or total disability. However, many other injured persons, after receiving adequate care during the emergency, do not reach the anticipated result, with consequent long convalescence and failure to return to gainful employment.

Evidence of such end results is found in the fact that although 4,430 persons injured on the job while under workmen's compensation were returned to work in 1951 under the federal-state program of vocational rehabilitation, the average time lag between injury and referral for rehabilitation was seven years. Many factors undoubtedly operate to produce such prolonged disability. Legal entanglements permitted by existing unrealistic compensation laws are an example. But many patients could have been restored to gainful employment in a far shorter period of time if they had received more careful medical supervision.

Those interested in the field of rehabilitation, including the federal government and many lay organizations, of which organized labor and management are representative, are much more cognizant than the medical profession of the prolonged disabilities that may result despite surgical proficiency.

The training of the average surgeon from the time he enters medical school through his internship and residency is devoted almost exclusively to the management of emergencies and immediate convalescence. The postgraduate courses stress the importance of accurate diagnosis and technic in handling

*Clinical Professor of Orthopedic Surgery, Tufts College Medical School, Boston; Visiting Surgeon, VI Surgical Service, Boston City Hospital.

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1. Waters, E. G., and Wager, H. P.: Amer. J. Obstet. & Gyn. 60:885, 1950.

the acute lesion. Medical literature abounds in technic.

Nowhere in the entire over-all picture is emphasis laid upon the importance of aftercare. Nowhere does a profound appreciation appear of the problems that confront a patient. We in medicine are apt to feel that, once the wound is healed and fracture united, we have done our job. If we have done a fine surgical job, we believe a good end result must ensue. Nothing could be further from the truth.

Responsibility to the patient does not end with the healing of surgical wounds—in fact, the real difficulty may then begin. Failure to recognize the importance of adequate surgical aftercare, including not only the specific therapy required for a maximum end result, but the recognition and treatment of the medical and psychologic complications of trauma, represents the basic weakness of modern day medicine.

To those interested in the field of trauma, the aim should be the restoration of the injured to self-sufficiency or to gainful employment at the highest attainable skill in the shortest possible time. This should be the concept of rehabilitation. Rehabilitation does not mean physical medicine exclusively, nor can the term be applied to vocational training or the correction of the psychologic effects of trauma. Physical medicine, psychiatry, and vocational training are invaluable to complete restoration but must be considered only as adjuncts in our over-all concept of true rehabilitation.

On what, then, does successful rehabilitation depend? It depends first upon the extent and severity of the injury and the efficiency with which emergency first aid and transportation are carried out.

Successful rehabilitation depends secondly upon the most important factor of all—the immediate definitive surgical care. In any injury, the exact nature and extent of the lesion must be recognized. No form of physical medicine or vocational training can compensate for or obviate inadequate surgical care. To insure maximum restoration of function, physicians must recognize their own limitations and not hesitate to call in those more capable of treating the injury.

Of almost equal importance is adequacy of treatment in the convalescent period. In this phase of treatment we have fallen down badly, and here the gains in surgical proficiency made in the past are apt to become nullified. Surgeons must learn the direct effect that aftercare has on the eventual result.

Utilization of the minimum amount of splinting to permit early active use of uninvolved muscles and joints is of utmost importance in the restoration of function. The early active exercise of the injured extremity is vitally important in prevention of muscle atrophy and joint stiffness, particularly if long immobilization is required.

In fractures of the wrist, for an example, minimum splinting and early motion do much to prevent the stiff fingers and frozen shoulders which often delay the return of function long after the fracture is healed. How many patients with

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1. Parsonnet, A. E., et al.: J. M. Soc. New Jersey 47: 504, 1950.

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fractures of the ankle are retarded in resuming work because of an atrophied quadriceps that does not sustain the body weight after removal of the cast?

Of equal value are general body exercises. Most patients confined to bed are not so completely immobilized that they cannot partake of activity to maintain general muscular tone. How many patients confined to bed for weeks are unnecessarily retarded in ambulation because their general body tone has been allowed to deteriorate from lack of exercise which could have been given?

All patients, particularly those who are ambulatory and at home, and especially when freed of all apparatus, must be given exercises, including work therapy, that will restore function to the greatest degree most quickly.

The patient must be given specific instructions as to how, when, and why the exercise is done. The surgeon must learn the nature of remedial measures and pay scrupulous attention to the detail of treatment. Unfortunately, many feel that they have no time for such supervision.

At the present time, great demand exists on the part of many lay groups for the establishment of special rehabilitation centers. This demand is prompted by the realization that adequate aftercare cannot be or is not given by the attending physician. The need for these facilities cannot be denied.

The real need, however, is for the physician to realize that, once he has undertaken the care of a patient, his obligations to that patient end only when restoration to as near normal as possible has actually been accomplished. The physician must, therefore, learn how to administer the most efficient type of aftercare or to utilize the services of individuals or institutions capable of doing so.

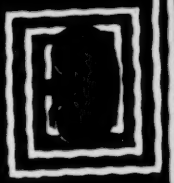
Convalescence from a traumatic lesion may be retarded by the development or exacerbation of intercurrent medical conditions. Not infrequently, diabetes, nephritis, or anemia may be present and, undetected, do much to prevent recovery. In such cases a competent internist may prove of great value.

Another factor which all too frequently delays convalescence or causes total disability is the psychologic complication of trauma. In some unstable individuals neurosis or mental depression develops to such a degree as to require psychiatric assistance. The longer this condition is allowed to exist, the more fixed it may become. The psychiatrist should be called when this complication is recognized.

In many instances, however, depression is brought on, particularly in patients past middle age, by a feeling of insecurity from loss of income, loss of job, and mounting family expenses. Worry over inability to meet mortgage payments or to keep children in school has a deleterious effect on recovery.

These psychologic effects of injury delay recovery and must be considered as real complications of trauma. Frank discussion with the patient usually reveals the cause of anxiety and often does much to re-

Hypertension



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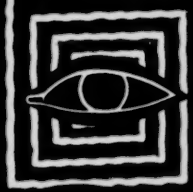

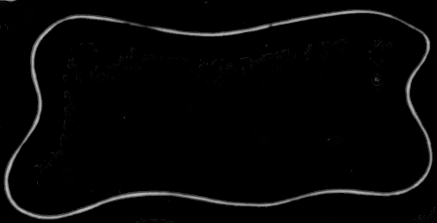

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lieve the patient's mind, even if nothing else is accomplished. Not infrequently, the physician knows how temporary financial assistance may be obtained and thus can afford some measure of relief.

If the cause for concern proves to be loss of a job or inability to return to regular work, a telephone call by the doctor to the employer may bring forth a promise of the old job or of some new work.

Knowledge that a job is available upon recovery does much to relieve the defeatist attitude and proves a stimulus to recovery.

The solution of such sociologic problems may hardly seem the duty of the physician. Patients, however, look to physicians not only for physical help but also for psychologic and, at times, spiritual help. The psychological effects of trauma are as real and as important as any surgical complication.

In some instances the injury precludes any possibility of return to regular work. When this fact is obvious, the patient and his family should be informed as soon as it is thought prudent. Efforts should then be made to contact some institution or agency interested in vocational training. The sooner such training is started, the earlier the patient will return to work at his highest attainable skill.

Many people have been injured on a job because they had neither the physical nor psychologic requirements for the task. Vocational training based on the natural aptitudes of the patient frequently results in a better job. This argument may carry much weight with individuals who feel that they are too old to learn a new trade.

Every state in the union has an office of vocational rehabilitation which operates in cooperation with the Federal Office of Vocational Rehabilitation. Under this federal-state program, not only is vocational training provided, including the expense of the training, but necessary surgical procedures and rehabilitation services may also be provided if a probability of return to gainful employment exists. Numerous other institutions, both public and private, interested in rehabilitation, are in operation.

No one is in a better position to see that these facilities are utilized than the attending physician, yet most physicians are unaware of the existence of such institutions. Our medical societies could render a great service by familiarizing their members with the existence of rehabilitation institutions and how their services may be used.

Obviously, much work must be done to restore an injured person to gainful occupation at the highest attainable skill. The physician must stick by the patient and watch for any complication, medical or psychologic, which will divert the patient from the plotted course. He must see that the patient gets the type of aftercare which insures maximum recovery in the minimum of time. If the patient is referred elsewhere, the physician must see that the treatment does not lag. Recovery must be continuous and at all times supervised. The hand most capable of controlling progress is the physician's.

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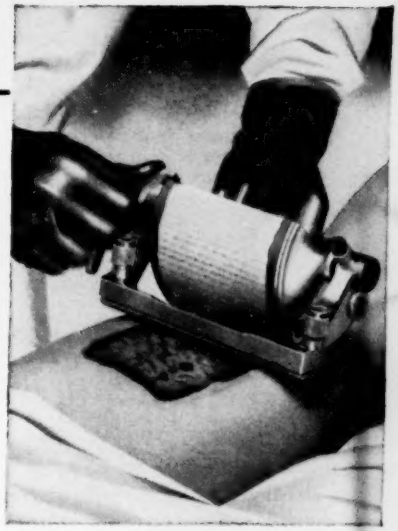

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†Dermatape was developed by John D. Reese, M.D., Clinical Professor of Plastic and Reconstructive Surgery, Jefferson Medical College, Philadelphia, in conjunction with the Irvington Insulator & Varnish Co., Irvington, N. J., and the Lee Tire & Rubber Co., Conshohocken, Pa. Used with the Reese Dermatome, manufactured by the Bard-Parker Co., Inc., Danbury, Conn.

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Medical Forum

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Obstetric Anesthesia*

Comment invited from
E. M. Papper, M.D.
Milton Smith Lewis, M.D.

► TO THE EDITORS: Among the more difficult questions in anesthesiology is that posed by *Modern Medicine:* "What is the most satisfactory obstetric anesthesia?"

The papers by Dr. William G. Caldwell on low spinal anesthesia and by Drs. R. A. Gordon and M. Vivyan Morton on trichlorethylene illustrate only two answers to this question, which has had a great many other suggested solutions. The results described in both studies are eminently satisfactory. However, equal claims have been presented for most of the other anesthetic agents and technics currently and historically available. The question is far from settled.

A method of providing satisfactory obstetric anesthesia should include several features:

1] Pain relief must be adequate.

2] Progression of labor should be interfered with not at all or minimally.

3] The anesthetic method should provoke no undue obstetric complications.

4] There should be no significant effect upon the fetus.

*MODERN MEDICINE, Apr. 1, 1952, pp. 97-98, 99-100.

I am not aware of any method of anesthesia which can meet these requirements. Efforts should be made to reach these goals, since maternal mortality is not completely eliminated by any method of anesthesia thus far described. Furthermore, although the mortality rate of the newborn has been significantly improved, this period of life is still perhaps the most vulnerable. Without doubt, the vulnerability of the newborn is related, at least in some part, to the anesthetic experience of the mother.

One can make an almost equally good case for inhalant anesthetic agents of the type described by Drs. Gordon and Morton (trichlorethylene) and other agents which act for a short time without producing significant side effects. Nitrous oxide and oxygen (at least 20% oxygen) and divinyl ether are two other agents which have proved satisfactory. Ether, cyclopropane, and ethylene have also been used, and if considerable care is exercised to avoid the anoxia associated with obstructed respiration and the undue depression of profound narcosis, these agents are also helpful in obstetric problems.

Satisfactory obstetric anesthesia has been obtained with conduction methods. Among them, caudal

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block, either fractional or in single dose, low spinal anesthesia, and local or pudendal block have found considerable use. The combination of lumbar sympathetic block and light nitrous oxide–oxygen inhalation for the actual delivery has also been satisfactory.

One gains the impression from studying the reports in the light of practical experience, that almost any method precisely and intelligently managed can provide equally good results from the standpoint of mother and baby. In fact, at the Sloane Hospital for Women most of the methods and agents which have been described are employed with apparently little difference in the influence upon maternal complications or fetal morbidity or mortality. Obstetric anesthesia, then, is the most satisfactory when methods currently available are intelligently used. Particular care must be exercised to minimize the complications inherent in each one.

E. M. PAPPER, M.D.
New York City

► TO THE EDITORS: In the use of lower spinal anesthesia in vaginal delivery, we have had considerable experience and agree with Dr. Caldwell that any physician with a reasonable amount of training and proper obstetric judgment and technic can administer saddle block anesthesia for the relief of pain during labor and delivery with a high degree of safety.

We would like to emphasize that individualization is of paramount importance in the selection of any agent for the production of obstetric analgesia and anesthesia. The contraindications as outlined are sound.

In our series of cases, satisfactory analgesia was produced by Delvinal, 6 gr., with Demerol, 100 mg., and scopolamine, 1/150 gr. This not only produces good analgesia but allays any fear of the needle and assures the patient's full cooperation.

Responsibility of the anesthetist obstetrician does not end with the insertion of the needle. Careful attention to the patient is an equally important prerequisite to success and complete safety, and the patient must be followed closely by a competent attendant throughout labor and delivery.

Spinal anesthesia is ideal in the presence of respiratory infection, tuberculosis, asthma, cardiac disease, toxemia, preeclampsia, hypertension, diabetes mellitus, and premature deliveries. The chief disadvantages in our series of cases were nausea and vomiting, hypotension, and postspinal headache.

We would like to emphasize that ergotrate intravenously should not be administered during lower spinal anesthesia. We had one fatality that occurred a few minutes after the administration of this oxytocic.

Our results with lower spinal anesthesia in vaginal deliveries have been highly satisfactory. The agent can be administered with safety by trained, competent personnel familiar with the technic and thoroughly aware of the dangers encountered in such a procedure.

MILTON SMITH LEWIS, M.D.
Nashville

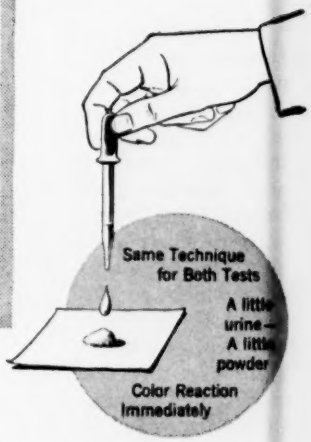
Glycosuria and Ketonuria in Patients Receiving ACTH or CORTISONE*

All patients should have a complete urinalysis before receiving corticotropin (ACTH) or Cortisone. Particular attention should be paid to the presence of glucose or acetone in the urine.

Frequent testing of the urine for sugar and acetone is recommended during the administration of ACTH or Cortisone.

The proper examination of the urine for sugar during treatment with ACTH or Cortisone may reveal a number of prediabetics.

Increase in insulin dosage is often required in the diabetic patient receiving ACTH or Cortisone.



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Galatest and Acetone Test (Denco) require no special laboratory equipment, test tubes, liquid reagents, or external sources of heat.

One or two drops of the specimen to be tested are dropped upon a little of the powder and a color reaction occurs immediately if acetone or reducing sugar is present.

Patients are easily taught to use Galatest and Acetone Test (Denco).

Write for descriptive literature.

THE DENVER CHEMICAL MFG. CO., Inc.
Dept. 92-Q 163 Varick Street, New York 13, N. Y.

***BIBLIOGRAPHY**

"Cortisone"—J. M. Carlisle, M.D., A. Gibson, M.D., E. Schmatolla, M.D.—Postgraduate Medicine, Aug., 1950.

"Oral Cortisone Therapy in Intractable Bronchial Asthma"—E. Schwartz, M.D.—Journal of the American Medical Association, December 29, 1951.

"Cortisone (Compound E), Summary of Its Clinical Uses"—J. M. Carlisle, M.D.—British Medical Journal, September 9, 1950.

"Cortisone and ACTH—A Review of Certain Physiologic Effects and Their Clinical Implications"—Randall G. Sprague, M.D.—American Journal of Medicine, May, 1951.

Diagnostix

Here are diagnostic challenges presented as they confront the consultant from the first clue to the pathologic report. Diagnosis from the Clue requires unusual acumen and luck; from Part II, perspicacity; from Part III, discernment.

Case MM-222

THE CLUE

ATTENDING M.D: The next patient is a 30-year-old woman whose chief symptoms are weakness and shortness of breath. This began with a severe cold about three months ago, which persisted for three weeks. She has had a cough since that time and raises small amounts of frothy sputum, never with blood and never with a bad odor. She has now come to the hospital.

VISITING M.D: This is a chronic disorder. What symptoms brought the woman to the hospital?

ATTENDING M.D: Malaise and dyspnea were definitely increasing for a week. She has no fever or chest pain.

VISITING M.D: The important question is: What does the roentgenogram show?

ATTENDING M.D: There are increased lung markings in all fields. In the lower part of the right chest is a density which obliterates all regular lung markings. The bronchogram is normal; the bronchoscopic examination showed nothing abnormal. Vital capacity was only 25% normal.

VISITING M.D: Has the sputum been examined for tuberculosis and for cancer cells?

ATTENDING M.D: Yes. The laboratory reports no cancer cells and no tubercle bacilli on smear, after concentration or in the gastric contents. Sedimentation rate is normal; sputum has been injected into animals and cultured. The patient does not have fever or clubbing of the fingers. Would fluoroscopic examination help us?

VISITING M.D: I think we should do a fluoroscopic examination but doubt that anything will be definitely contributed. The problem is that this woman has some diffuse pulmonary disease, greater in the right lower lobe. The question is whether the condition is inflammatory, degenerative, or neoplastic. We really have no good evidence, but I think . . .

New aureomycin minimal dosage for adults—four 250 mg. capsules daily, with milk.

Library, Union League Club, Philadelphia, Pa.

From among all antibiotics, Dermatologists often choose

AUREOMYCIN

Hydrochloride Crystalline

because

Aureomcyin provides mild bacteriostasis in diseases of the skin.

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Throughout the world, as in the United States, aureomycin is recognized as a broad-spectrum antibiotic of established effectiveness.

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Ophthalmic: Vials of 25 mg. with dropper; solution prepared by adding 5 cc. distilled water.

LEDERLE LABORATORIES DIVISION AMERICAN Cyanamid COMPANY
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PART II

VISITING M.D: . . . that the patient has a tumor, and that it is widespread, beyond surgical relief. We will observe her for a time.

VISITING M.D: (*One month later*) The patient has progressively lost weight and is quite debilitated. Dyspnea has increased but she has no fever. A process has now started in the left lower lobe and the one in the right lung is definitely spreading. Results of tests for organisms are still negative. I am inclined to think this is a case of . . .

PART III

VISITING M.D: Pulmonary adenomatosis. We will know before long.

PATHOLOGIST: (*At autopsy three weeks later*) Significant findings are limited to the chest. We find no pleural adhesions, no fluid in the pleural cavity. The lungs are firm and nodular and cut with resistance. The lesions are of miliary type without caseation or necrosis which tend to coalesce and become large. The bronchi are normal without cavities or ulceration. I wonder if this is a case of Boeck's sarcoid?

VISITING M.D: Or pulmonary adenomatosis.

PATHOLOGIST: Possibly.

PATHOLOGIST: (*One week later*) I believe the pathologic picture is more consistent with pulmonary alveolar adenomatosis than anything else. We find no mitotic figures; I think the cells which fill the lung are bronchogenic in origin. Except for slight fibrosis, the alveolar stroma is healthy and without invasion by the cells which seem to be piling up in the alveoli. Immediate lymph nodes are normal.

PART IV

VISITING M.D: All attempts to isolate organisms responsible for pulmonary adenomatosis have failed. Some people believe this is a tumor. Characteristically there is an insidious onset and a steady progression: cough, râles, and progressive pulmonary decompensation. Alveolar adenomatosis in human and bovine disease appears to be similar. This is not the same as alveolar cell carcinoma, although the same controversy arises as to the origin of the cells—are they bronchogenic or from the alveoli? I don't know whether this is a neoplasm and if so, whether benign or malignant. Certainly all patients with the lesion die. It does not metastasize. The disease kills by progressive diminution of respiratory capacity. Roentgen diagnosis is difficult if not impossible to make. Perhaps nothing short of thoracotomy and biopsy of the tissue will make a diagnosis in a living patient. No treatment is known.

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THE BURDICK CORPORATION

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short REPORTS

Circulation

Estrogen and Atheroma

Not only is coronary atherogenesis in chicks prevented by oral doses of estrogen, but lesions already formed are reduced. Chicks fed a mash containing 2% cholesterol and 5% cottonseed oil have well-developed lipid plaques in the coronary arteries within five weeks. After daily 1-mg. injections of estradiol benzoate for the next three weeks with the same diet, few coronary lesions remain, and little or no fat is seen in residual plaques, reports Dr. Ruth Pick of Michael Reese Hospital, Chicago. The intima is free of lipid, and remaining deposits are found in the media, adventitia, and perivascular connective tissue.

Federation Proc. 11:122-123, 1952.

Hormones

Parathyroid Tetany

Benemid in daily doses of 2 gm. relieves tetany caused by chronic parathyroid deficiency. The serum phosphate level drops approximately to normal in one to three days, observe Dr. William S. Hoffman and associates of the University of Illinois and Loyola University, Chicago. In 1 instance, the symptoms were completely relieved for four months, although tetany recurred when Benemid dosage was stopped. Serum calcium levels rose only slowly after weeks of therapy, showing a dissociation from phosphate levels not seen with parathyroid hormone therapy. Benemid reversibly inhibits tubular excretion of penicillin or *p*-aminosalicylate and tubular reabsorption of urate. In subjects with intact parathyroids, inorganic phosphate reabsorption by tubules is not halted, possibly because of the regulatory action of parathyroid hormone.

Federation Proc. 11:231, 1952.

Neurology

Anticonvulsant Drug

Dormison, a tertiary alcohol with hypnotic effect, is also antiepileptic. At Stanford University, San Francisco, Dr. Ralph W. Schaffarzick and Beverly J. Brown found a wide margin between therapeutic and toxic doses. In rats, 48 mg. per kilogram reduced seizures, 102 mg. caused ataxia, and 250 mg. induced sleep. The drug had a synergistic action with phenobarbital. When adults were given capsules containing 250 mg. four times daily, grand mal convulsions were controlled well in 3 of 4 cases and petit mal in 1. The only undesirable reactions noted were irritability and some insomnia. A special advantage was smooth action with relatively infrequent administration.

Stanford M. Bull. 10:106-109, 1952.

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In ulcers, wounds, burns and dermatoses,
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Anticonvulsants

Control of Seizures

Grand mal and psychomotor attacks may be controlled by Hibicon, a compound differing pharmacologically from other anticonvulsants. Petit mal is not affected. The drug is known chemically as N-benzyl-β-chloropropionamide. In using the oral route, Dr. C. D. Hawkes of the University of Tennessee, Memphis, giving the drug three or four times daily, with barbiturates in some instances, reports adequate control was achieved in 39 of 59 patients. The adult dose ranges from 1 to 2 gm.; the children's dose from 0.25 to 0.5 gm. Toxic reactions and side effects are uncommon. Hibicon, when effective, is preferred even by patients whose convulsions have been treated successfully by other agents.

J. Neurol. & Psychiat. 67:815-820, 1952.

Industrial Medicine

Health of Uranium Workers

No health damage from radioactivity has been found in more than 1,100 workers in the uranium mines and mills of Colorado, Utah, New Mexico, and Arizona. In an interim report released by the Public Health Service, Surg. Gen. Leonard A. Scheele expresses the belief that, with exercise of proper precautions, a man should be able to do any potentially harmful job without danger. American miners, working fewer hours on a one-shift basis, are not exposed immediately following blasting, when radiation levels are highest. From a study in progress since 1950 under Dr. Seward E. Miller, chief of the division of occupational health, specific recommendations have evolved for the control of noxae. Among the most important are provisions for adequate ventilation, wet drilling, personal hygiene including daily showers and frequent change of work clothes, and preemployment and periodic physical examinations.

Antibiotics

Chloramphenicol Toxicity

A rare idiosyncrasy to chloramphenicol may cause fatal aplastic anemia. Although thousands of people are treated with no depression of bone marrow, the drug should be reserved for dangerous infections by organisms known to be susceptible. Several patients have succumbed in different parts of the country, including 3 children of physicians. A 71-year-old woman and a man of 92 died of purpuric cerebral hemorrhage, each after 2 courses of therapy administered some weeks apart, as reported by Drs. D. B. Claudon and A. A. Holbrook of Columbia Hospital, Milwaukee. Fatal aplastic anemia of a young man and 2 little girls after prolonged intermittent therapy with chloramphenicol were observed by Dr. R. K. Smiley and associates of the University of Utah, Salt Lake City. Dr. Phillip Sturgeon encountered 6 fatalities at Los Angeles Children's Hospital. In at least 4 instances, prolonged intermittent medication was given in small doses for minor illness.

J.A.M.A. 149:912-922, 1952.

you . . . and your hypertensive patient . . . have a right to expect

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In long-term therapy, when the patient fails to get consistent hypotensive effect from nitrites, consider the possibility of developed *tolerance.*

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1. Goodman and Gilman: *The Pharmacological Basis of Therapeutics;* New York, The Macmillan Co., 1941.

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Nutrition

Eskimo Metabolism

The high basal metabolism of Eskimos in their native habitat is partly the result of the specific dynamic action of protein. Among 73 Eskimos from 4 localities, Dr. Kaare Rodahl of the Ladd Air Force Base, Alaska, noted highest values with the largest protein intake. The average basal metabolic rate fell from plus 8% to minus 8% on shift to the white man's diet and rose to the former level with return to the customary meals. Eskimo and white subjects had identical basal metabolic rates under the same living conditions. The average level of 14 natives living on native food was 8% above the DuBois standard.

Federation Proc. 11:130, 1952.

Nutrition

Calcium Absorption

The proportion of a supplementary calcium ration absorbed is related to the type of food eaten, find Drs. Billy M. Hightower and Edward F. Williams, Jr. At the University of Tennessee, Memphis, young rats were fed 16 gm. of lean meat a day for five days. At the end of the third day, each animal received by stomach tube 5 mg. of radioactively labeled calcium, as did rats eating glucose and Celluflour. Urine and feces were collected for two days, and tissues were examined post mortem. The rats that ate the meat absorbed 46% of the administered calcium and the others, 68%.

Federation Proc. 11:230, 1952.

Diabetes

Acetone in the Breath

Significantly higher amounts of acetone are exhaled by normal nonfasting females than by males, but in both the quantities are much smaller and less variable than in diabetic patients. Margaret J. Henderson, M.A., and associates of the University of Toronto and the Western Reserve University, Cleveland, found the range in the healthy group to be from 1.3 to 12.7 μg. per gram condensate per square meter of body surface compared with 2.3 to 42.6 μg. in the diabetic group. More acetone is exhaled by young than by old diabetic patients.

Diabetes 1:188-193, 200, 1952.

Otology

Test for Perceptive Deafness

Conductive deafness may be distinguished from perceptive deafness simply by measuring hearing acuity before and after placing a small amount of glycerin in the external auditory canal. Normal ears lose 45 to 60 decibels at 2,048 cycles per second after instillation. All of 20 persons with perceptive deafness examined by Drs. Tokuro Suzuki and Takeshi Hirose, Shinshu University, Matsumoto, Japan, had losses of 30 decibels or greater after glycerin was instilled. The effect of glycerin is much less with conductive deafness; a loss of 15 decibels or more was observed in only 4 of 32 cases. The glycerin test is not indicated if the hearing loss is less than 40 decibels before instillation.

Arch. Otolaryng. 55:465-467, 1952.

A vagal blocking agent for peptic ulcer with LOW incidence of SIDE EFFECTS

PRANTAL* methylsulfate (diphenmethanil methylsulfate) is an effective anticholinergic agent for treatment of peptic ulcer. Pain, pyrosis, nausea, and other symptoms of this syndrome are rapidly relieved. Troublesome side effects seldom occur.

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Radioactivity

Radiation Effects on Fertility

Genetic damage resulting from irradiation indicates that extreme caution should be exercised in the voluntary exposure of humans to relatively low levels of ionizing rays. In controlled tests on rabbits at Oak Ridge, Tenn., Dr. R. L. Murphree and associates of the Veterinary Corps, U.S. Army, found that treatment of males with 100, 200, or 300 r prior to mating may increase the frequency of resorption of whole litters in normal females. The greater loss of eggs in each of the groups examined suggests either some interference with fertilization or such early fetal death that decidual reaction resulting in development of the placentoma was not initiated.

Science 115:709-711, 1952.

Diagnosis

Trichomonas and Cancer

Chronic infestations with *Trichomonas* can produce such atypical changes in the cervical epithelium that differentiation from carcinoma in situ is difficult. Presence of the organism and the associated cell atypia, superimposed upon radiation sequelae in a smear from a treated carcinoma patient, are not rare. Eleanor Bechtold, R.N., and Norbert B. Reicher, M.D., of the Syracuse Memorial Hospital and the State University of New York, Syracuse, emphasize the importance of obtaining endocervical samples with a sharp curet, preparation of multiple sections of the biopsy material, and comparison of repeated samples. Cells of true carcinoma in situ are in no way different from those of an early invasive tumor. Cytologic and histologic study has established the following diagnostic criteria: Carcinoma in situ tends toward anaplasia; the lesion starts in the germinal layer and works outward, and the process is irreversible. Atypical changes caused by trichomonad invasion show prosoplasia, begin in the outer portions of the epithelial layer, and extend inward; these changes are reversible.

Cancer 5:442-457, 1952.

Obstetrics

Medical Abortion

A folic acid antagonist taken orally in the first trimester of pregnancy usually causes a deficiency resulting in death and spontaneous delivery of the fetus. At the University of Washington, Seattle, 6 to 12 mg. of 4-aminopteroyl glutamic acid was effective in producing abortion in 10 of 12 cases. The only maternal reaction was slight transient depression of hemoglobin and the leukocyte count. In 3 of the older embryos, including 1 of 54 days, the cranium was malformed. When removed surgically, 2 were alive; 1 died and was delivered spontaneously. Dr. John B. Thiersch warns that the drug should be employed for therapeutic abortion only when operative intervention is possible. Survival or death of the fetus cannot be proved by the usual pregnancy tests.

Am. J. Obst. & Gynec. 63:1298-1304, 1952.

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. . . for use when prolonged penicillin protection is desired:

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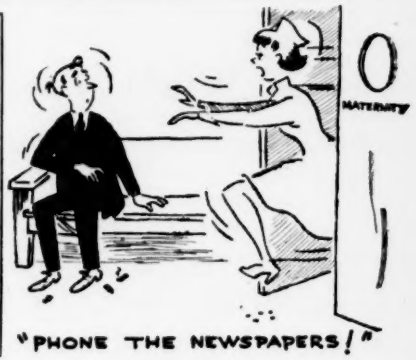

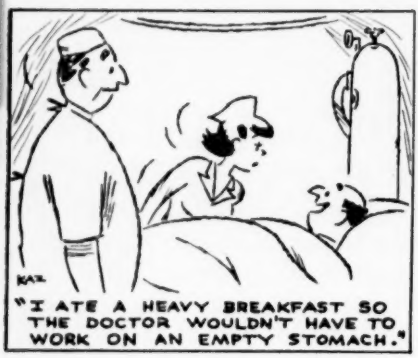

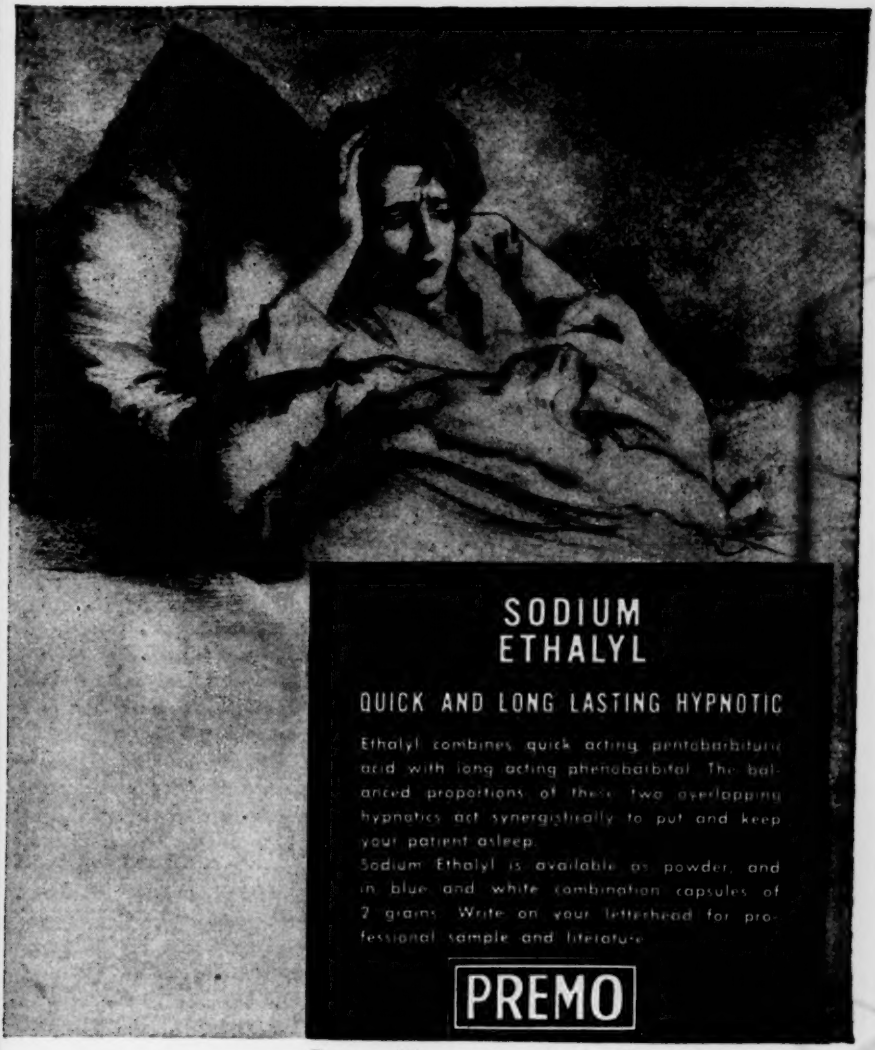

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FACTS ABOUT *Synthetic*

In only four years synthetic detergents have made a tremendous change in the household washing habits of American housewives. At the start of 1948 they accounted for less than 10% of the "laundry soap" business; by the end of 1951 they accounted for over 60%. The product enjoying the greatest popularity in this classification (Tide) is currently being used by one woman out of every four who do their own dishes, and one out of every three who do their own laundry.

For your information the Chemical Division of The Procter & Gamble Company has prepared this article, discussing some of the differences between synthetics and soaps which formerly were widely used.

How synthetic detergents differ from soaps

Synthetic detergents are organic compounds with molecules whose opposite ends are highly polarized like those of soap; one end consists of the type of structure which is oil soluble, the other consists of the type which is water soluble.

Magnesium and calcium soaps formed by interaction of sodium soaps with water hardness are among the most insoluble of compounds. The precipitation which occurs with soap in hard water wastes soap and causes cloudy glassware and unsightly deposits. The "tailor-made" molecules of synthetics do not form these insoluble compounds in hard water. They leave surfaces cleaner . . . free of any precipitated "soap film" formed during rinsing. Also, unlike soaps, in solution, synthetics can be used at almost any pH. Soaps must be kept at pH 10 or above, or they will split into fatty acids. Most synthetic products in general use have solution pHs from 6.0–10.0. Few are above the pH of soap.

The special washing abilities of synthetic detergents

As a consequence of the above characteristics, synthetics are particularly well-suited for washing off acidic soils which would destroy soap. Since they aren't destroyed by hardness or by salts of other metals as soaps are, they are well-suited to washing a great variety of things which could be washed only with alkalis before.

The effect of synthetic detergents on bacteria

The synthetics in general use have about the same effect on bacteria as soaps—that is, some germicidal effect on some strains, but for creating relatively sterile conditions they rely more on removing bacteria than on killing them.

Detergents

The effect of synthetic detergents on skin

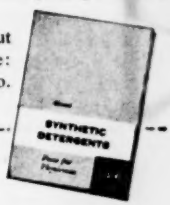
Over the past seven years, Procter & Gamble has included synthetic detergents in the continuing series of tests to measure the effect of washing products on skin. In addition to the routine patch and arm-immersion tests, Procter & Gamble has conducted, under careful medical supervision, extensive clinical and home-usage tests of all its products, including the new synthetics. These tests indicate that household detergents in use today, as a class, do not differ greatly in their effect on the skin from the general-purpose package soaps which have been used for years. Some have a lower pH than soaps and, hence, less effect on persons sensitive to alkali.

Like soaps, the detergents generally are mild primary irritants, but a fact not generally realized is that on the average person subjected to patch or immersion tests, most detergent solutions cause less skin reaction than do soap solutions.

Women have had many years in which to learn whether or not all soaps or certain soaps prove irritating. Problems arising from the effect of soap on skin have, therefore, been spread over decades. In the case of washday detergents, almost every woman in America was exposed to these products in a concentrated period of two or three years.

This widespread use of synthetics, together with their relative newness on the market, have resulted in a situation where synthetics are likely to be suspected as the cause of many cases of dermatitis where they probably are not involved. With almost all housewives now using synthetics for one or more purposes in their homes, it is inevitable that when a physician sees a case of hand dermatitis, a history of exposure to detergents will be obtainable. The significance of the dermatitis must be appraised against the background of the wide use of the detergent products.

FOR FURTHER INFORMATION, send for free booklet, "About Synthetic Detergents — Facts for Physicians." Write: The Procter & Gamble Co., Box 687F, Cincinnati 2, Ohio.



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Nothing Drab

I had just completed a physical examination of Mr. Five-by-Five whose protruding stomach had hidden his feet from his view for years.

"I am afraid, sir," I said, "you'll have to diet."

"Why?" he asked, "What color is it now?"—M.E.H.

The Promised Land

(Seen in *Publishers' Weekly* by S.A.D.)

Another custom which Mr. Bailey observed was that the store extended 100 per cent credit to medical students during their entire academic careers. They would order books and use them and after they were graduated would pay up. This proved to be a good policy, for physicians do very well in Sweden.

"Go slow. I get air-sick."

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1. Robinson, F. H., Jr., and Farr, L. E., Ann. Int. Med., 14:42 (1940)
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4. Bickers, W. and Woods, M., New England J. Med., 245:453 (1951)

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*Lehrer, H. W.; Lehrer, D. R., Lehrer, H. G.; Ohio State Med Jr. (Jan.) 1951.

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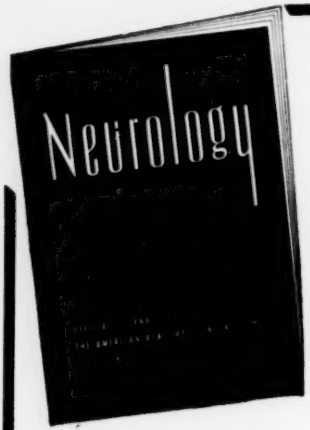

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3. Luduena, F. P., and Ananenko, Estelle: *Jour. Allergy*, 20:434, Nov., 1949.

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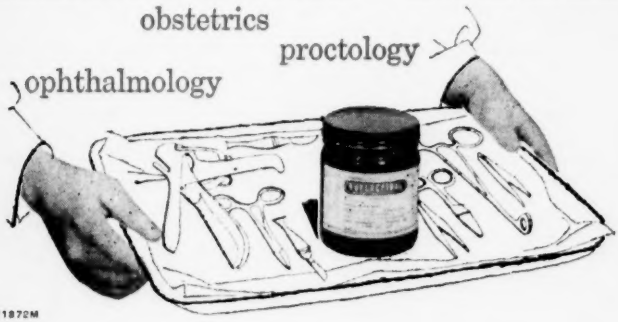

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